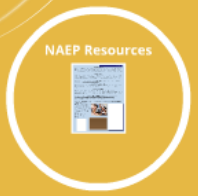
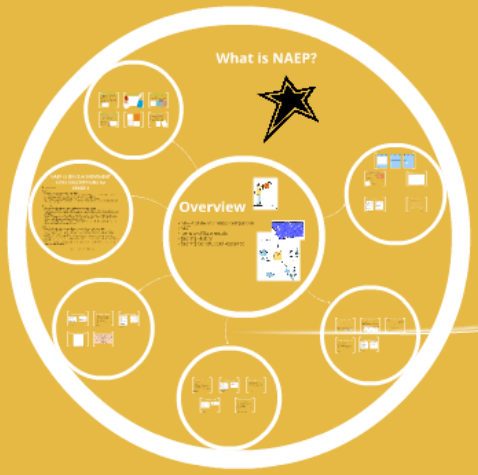
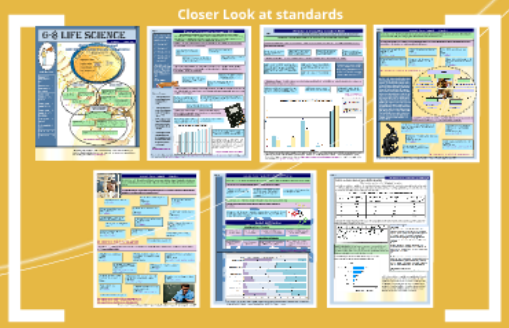
NAEP
MONTANA
NATIONAL ASSESSMENT OF EDUCATIONAL PROGRESS

NAEP
The One Stop Shop

By Ashley McGrath, NAEP State Coordinator
2013 MEA-MFT Conference October 17-18, 2013







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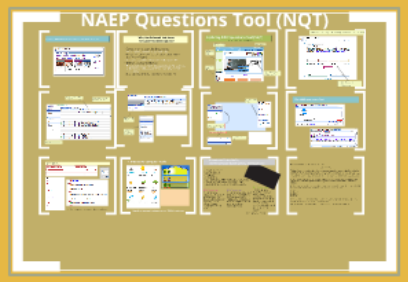

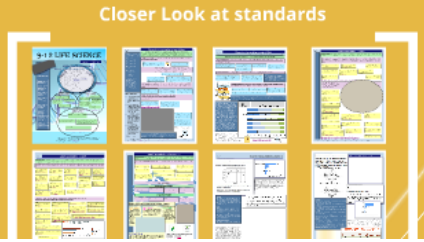

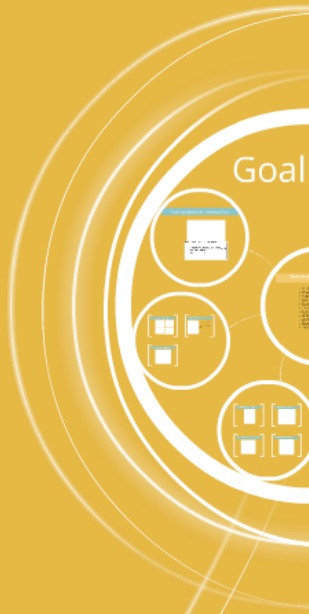

What is NAEP?

Overview

- NAEP, State and NGSS comparison
- NQT
- Items and State results
- Scoring History
- Scoring Constructed Response

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- NAEP, State and NGSS comparison
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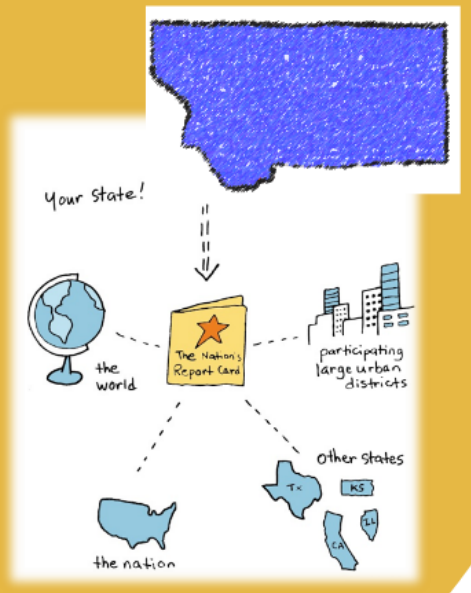
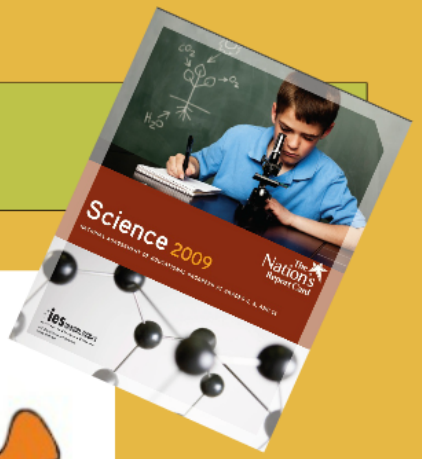


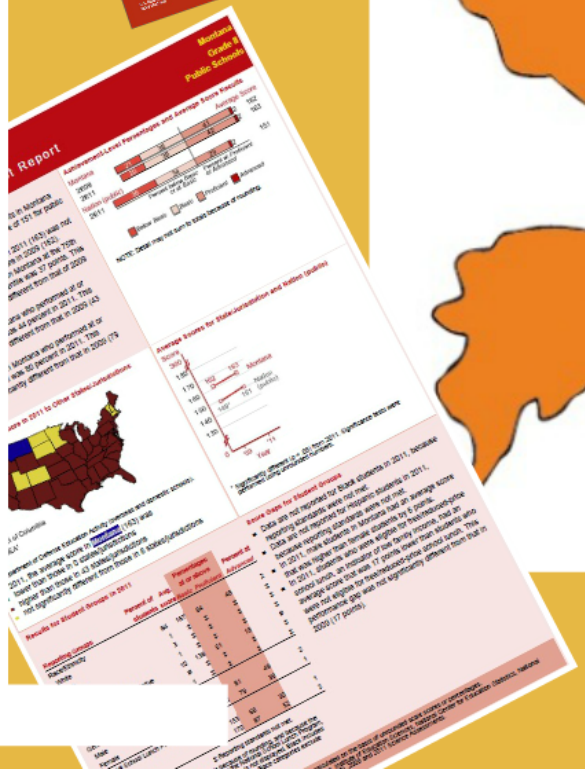
What is NAEP?

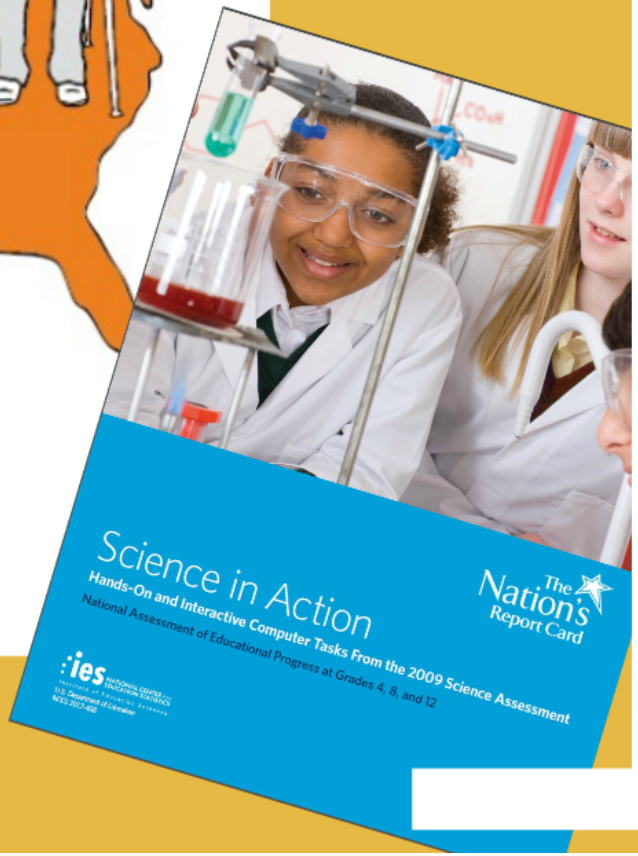
- Established by Congress in 1969 to measure educational progress in America
- Administered by the U.S. Department of Education's National Center for Education Statistics (NCES)
- Considered the 'Gold standard' of assessment
- 'Barometer' (i.e., indicator) for student performance
- Monitors achievement in a non-biased, independent fashion
- Provides accurate trends of what students know and can do
- Is a reliable and valid test that can demonstrate what Montana students know in math, reading and science
- "common yardstick"

Video: Introducing NAEP to Teachers (2012)

NAEP







Video: NAEP

NAEP

Results are released to the public as The Nation's Report Card.

http://nationsreportcard.gov/

Inform parents, the public, education policymakers, etc. about our nation's educational environment (e.g., cognitive data; student, teacher, and school questionnaires)

NAEP Testing Design

Long Test, Short Booklet

- Each student gets a small part of the test
- No individual student scores

Common Block Structures Across Subjects

P/P: 1st Block 25 min.	P/P: 2nd Block 25 min.	BQ1 5 min.	BQ2 5 min.

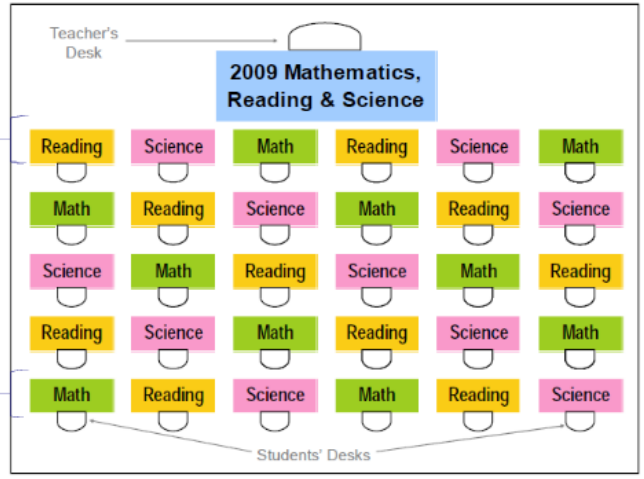
- Takes no more than 90 minutes from start to finish (P/P)
- Items within blocks, blocks within booklets [Balanced Incomplete Block (BIB) spiraling]

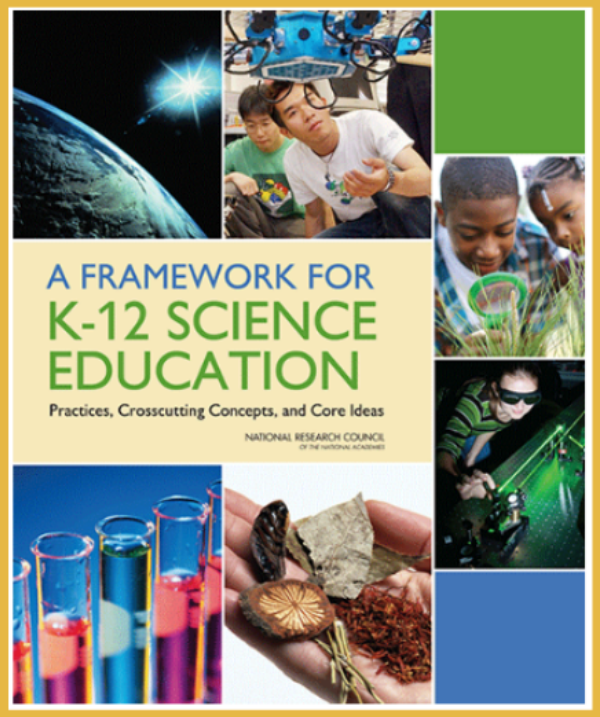
Test Questions

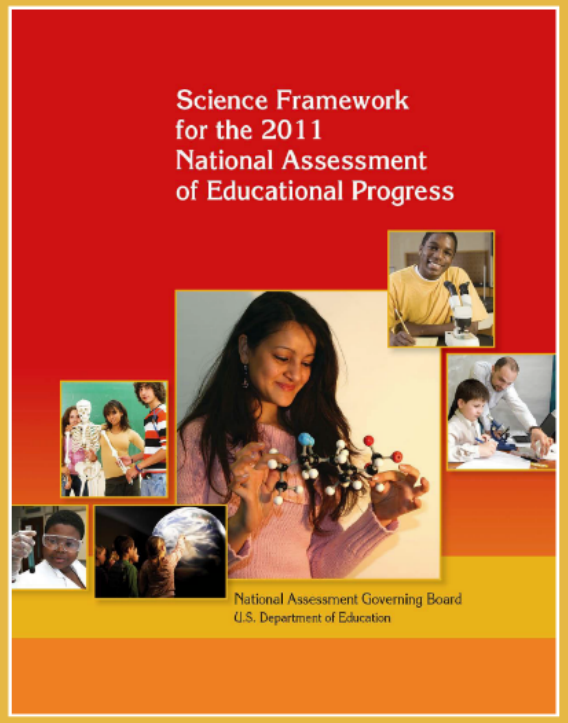
- MC, short constructed response, extended response, and computer based questions

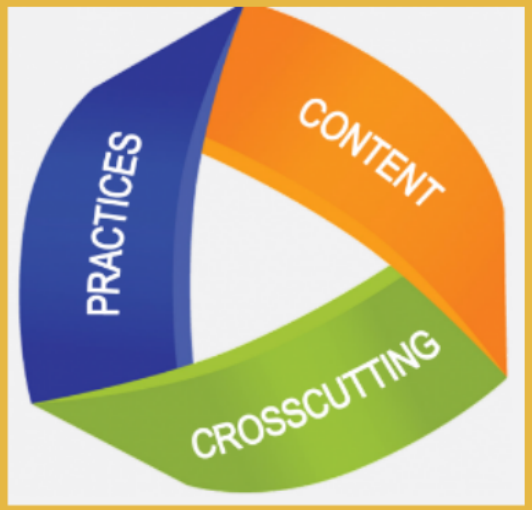
Contextual Items

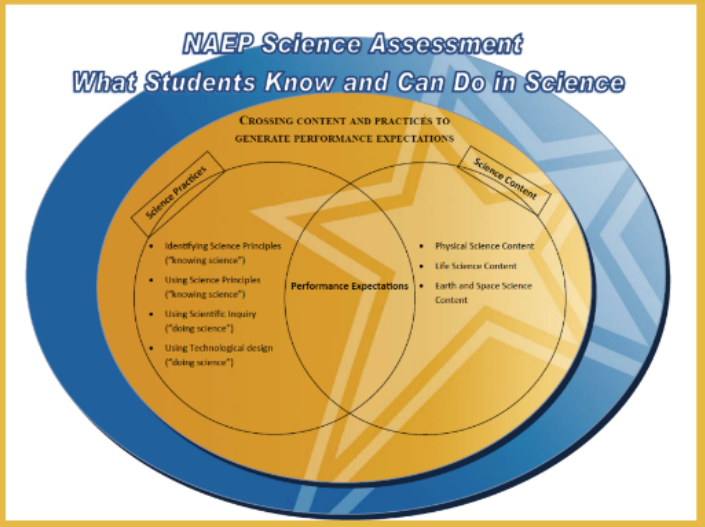
- Student, teacher, administrator questionnaires




A FRAMEWORK FOR
K-12 SCIENCE
EDUCATION
Practices, Crosscutting Concepts, and Core Ideas
NATIONAL RESEARCH COUNCIL


Science Framework
for the 2011
National Assessment
of Educational Progress
National Assessment Governing Board
U.S. Department of Education


PRACTICES
CONTENT
CROSSCUTTING

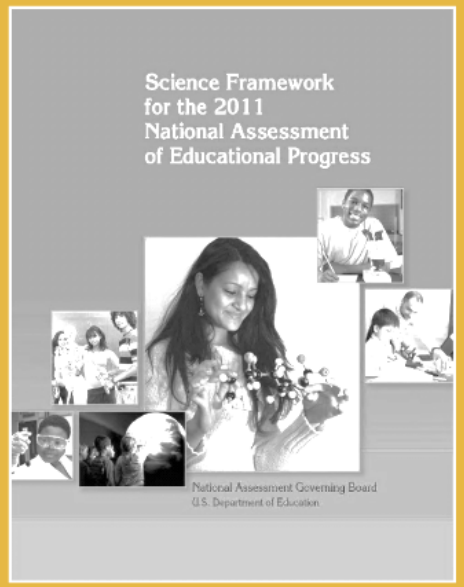

NAEP Science Assessment
What Students Know and Can Do in Science
Crossing content and practices to generate performance expectations
Science Practices
Science Content
Identifying Science Principles ("knowing science")
Using Science Principles ("knowing science")
Using Scientific Inquiry ("doing science")
Using Technological design ("doing science")
Performance Expectations
Physical Science Content
Life Science Content
Earth and Space Science Content

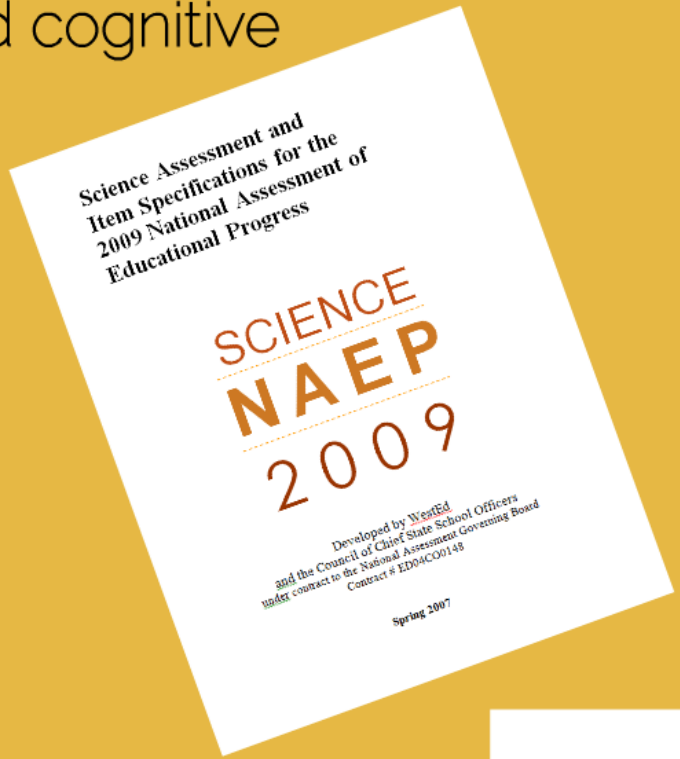
NAEP Framework & Assessment

- Current instructional and measurement issues

- Current instructional efforts and best practice

- Research on cognitive development and learning
- Provides detailed descriptions of the content and cognitive dimensions
- Distribution of items across content and cognitive dimensions





Understanding Objectives

Content Area Matrix Format
In the Framework

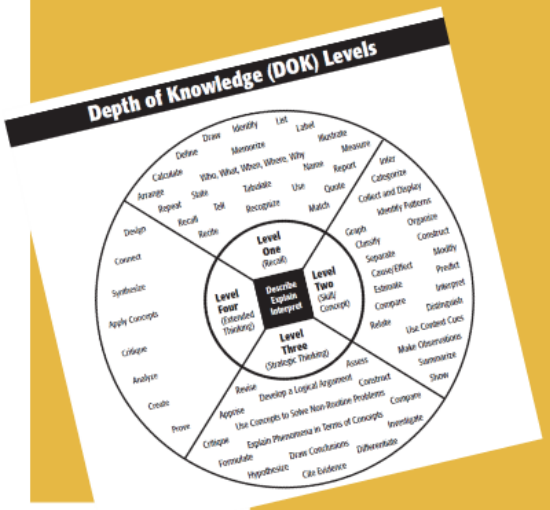
Content Area
- Identified by name or capital letters A-E when reviewing items

Subtopic
-Identified by a number

Grade level Objectives
-Identified by a small letter

In the Specification
-Additional information identified by italics under objective

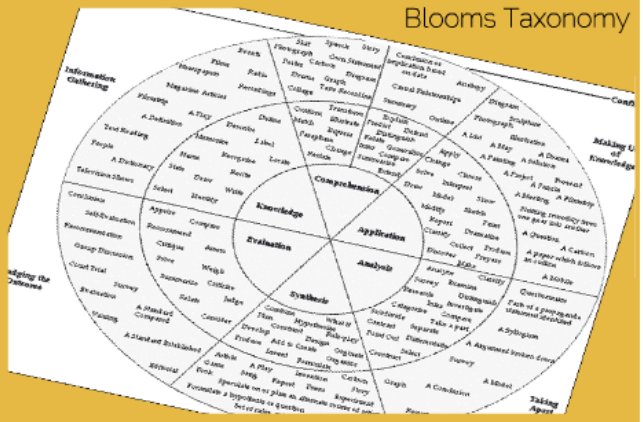
- Use of the word "or"
- Use of the word "and"
- Use of the word "including"
- Use of verbs (describe, analyze, and solve)
- Vocabulary (ratio vs. proportion)
- One objective can be a subset of another objective
- Multiple item classifications (primary versus secondary)



No one method was used but assemblage/ integration was used to construct NAEP's complexity

Kim Gattis. 2013. American Institutes for Research

Blooms Taxonomy



APPENDIX G

LIFE SCIENCE EXAMPLES OF GENERATING AND INTERPRETING ITEMS

Table 29. Life Science Content Statements Represented in Appendix G

Organization and Development
L8.1: All organisms are composed of cells, from just one cell to many cells. About… **L12.2:** Cellular processes are carried out by many different types of molecules…[a]
Matter and Energy Transformations
L8.4: Plants are producers—they use the energy from light to make sugar molecules… **L12.6:** As matter cycles and energy flows through different levels of organization of…
Interdependence
L8.7: The number of organisms and populations an ecosystem can support depends on… **L12.7:** Although the interrelationships and interdependence of organisms may generate…
Heredity and Reproduction
L12.8: Hereditary information is contained in genes, located in the chromosomes of…[a] **L12.9:** The genetic information encoded in DNA molecules provides instructions for…[a]
Evolution and Diversity
L4.7: Different kinds of organisms have characteristics that enable them to survive in…

[a]L12.2, L12.8, and L12.9 are grouped together to generate a single example. See "Heredity and Reproduction" section for this example.

Science Assessment and Item Specifications for the 2009 National Assessment of Educational Progress. Life Science Examples of Generating and Interpreting Items, P. 302-308

Matter and Energy Transformations

Grade 8: Structures and Functions of Living Systems—
Matter and Energy Transformations

Content Statement

L8.4: Plants are producers—they use the energy from light to make sugar molecules from the atoms of carbon dioxide and water. Plants use these sugars along with minerals from the soil to form fats, proteins, and carbohydrates. These products can be used immediately, incorporated into the plant's cells as the plant grows, or stored for later use.

Commentary

This content statement describes the basic matter transformations that occur in plants, making three key points:

- Plants "use" light energy to make "food" from substances that are not food: carbon dioxide and water. (Note that the statement "they use the energy from light" does not imply that energy is converted into matter or that energy is lost.)
- "Making food" is a chemical process. The atoms that make up molecules of carbon dioxide and water are rearranged to make sugar molecules.
- Plants use the food they make for two purposes: to provide materials for their growth and energy for their functions.
- Plants use sugars (and oxygen from the air), along with minerals from the soil, to form fats, proteins, and carbohydrates.

Students are not expected to know the terms photosynthesis or cellular respiration or to know the chemical intermediates in these processes. Students should be familiar with structural formulas for carbon dioxide, water, and oxygen. For 8th grade, terms such as "food making," "breaking down food," and "oxidizing/burning fuel" are acceptable. See p. 53 for textbox on "food."

Examples of Performance Expectations

Identifying Science Principles, Students can:

- Identify the raw materials that plants use to make sugars.
- Identify the reactants and products of plants' food-making processes (photosynthesis).
- Describe two possible ways that plants use the sugars they make.

Using Science Principles, Students can:

- Explain why many plants (e.g., grass, irises) grow better in the sunlight than in the shade.
- Predict what will happen to seeds (e.g., radish, grass) that sprout in the dark.
- Explain why sugars are found to move primarily down the stem of a growing plant (e.g., tree, bean plant).
- Explain why water is found to move primarily up the stem of a growing plant (e.g., tree, bean plant).
- Account for a plant's (e.g., maple tree, wheat plant, daisy) increase in mass from the molecular building blocks it makes.

Using Scientific Inquiry, Students can:

- Identify or state patterns in results from experiments on plant growth.
- Design experiments to assess factors affecting plant growth.
- Assess whether results of an investigation of plant growth are consistent with theoretical models.
- Critique or identify limitations of studies or investigations of plant growth reported in newspaper articles (e.g., investigations of the effects of carbon dioxide on plant growth).
- Criticize reasoning in arguments about claims that do not follow logically from data about plant growth under various conditions.

Performance expectations for Using Technological Design are not provided.

Item to Assess Identifying Science Principles

Item Suggestion

As a plant grows, what is the source of its food?

Interpretation: An acceptable answer should indicate that the student understands that the energy rich material made by a plant through photosynthesis is its food. For most students, plant nutrition is a major area of conceptual confusion, and food production through photosynthesis is a complex, abstract, and counterintuitive concept. As a result, students often have alternative conceptions of plant nutrition and growth that are not scientifically justifiable.

Items to Assess Using Science Principles

Item Suggestion 1

Where does a plant's increase in mass come from?

Interpretation: The acceptable response mentions that increase in weight comes primarily from conversion of carbon dioxide and water into plant matter as a result of photosynthesis (largely "schematic knowledge"). According to research, few students, even at the high school level, consider the conservation of matter and energy when thinking about plant growth and nutrition. Thus, if a student mentions that increase in weight of the plant comes from the material (nutrients) and water absorbed by the plant from the soil, then evidently the student is not linking photosynthesis with food production, is confusing nutrients with food, and is seeing food as providing only energy for living and not material for growth. This item suggestion draws primarily on "schematic knowledge."

Item Suggestion 2

Explain why water is found to move primarily up the stem of a growing plant (e.g., tree, bean plant).

Item Suggestion 3

Draw arrows to explain where water moves in a green plant. Explain why it needs to go there.

Interpretation: Most students should correctly draw arrows showing water going up the stem from the roots. Their reasons for why the water needs to go there, however, will be varied and revealing. Students who mention that plants need water for photosynthesis or for "making food" clearly understand a key idea in the content statement. Many students are likely to suggest that water is food for the plant or to describe the need of the leaves for water in vague terms (e.g., the leaves need water to live or to grow). Students who say that water is food for the plant are revealing a common naïve conception that does not recognize the role of plants as producers of sugar and other organic substances, i.e., food.

ding Objectives

en reviewing

- Use of the word "or"
- Use of the word "and"
- Use of the word "including"
- Use of verbs (describe, analyze, and solve)
- Vocabulary (ratio vs. proportion)
- One objective can be a subset of

Background:
NAEP Considers Conten

Exhibit 1. Crossing content and pra

	Physical Science Content Statemen

Background:
NAEP Considers Content and Practice

Exhibit 1. Crossing content and practices to generate performance expectations

		Science Content		
		Physical Science Content Statements	**Life Science Content Statements**	**Earth and Space Sciences Content Statements**
Science Practices	**Identifying Science Principles**	Performance Expectations	Performance Expectations	Performance Expectations
	Using Science Principles	Performance Expectations	Performance Expectations	Performance Expectations
	Using Scientific Inquiry	Performance Expectations	Performance Expectations	Performance Expectations
	Using Technological Design	Performance Expectations	Performance Expectations	Performance Expectations

NAEP 2009-2011 Science Framework

Comparison

NAEP Practices

Identifying Science Principles
- Describes, measure, or classify observations.
- State or recognize correct science principles.
- Demonstrate relationships among closely related science principles.
- Demonstrate relationships among different representations of principles.

Using Science Principles
- Explain observation of phenomena.
- Predict observations of phenomena.
- Suggest examples of observations that illustrate a science principle.
- Propose, analyze, and/or evaluate alternative explanations or predictions.

Using Scientific Inquiry
- Design or critique aspects of scientific investigations.
- Conduct scientific investigations using appropriate tools and techniques.
- Identify patterns in data and/or related patters in data to theoretical models.
- Use empirical evidence to validate or criticize conclusion about explanations and predictions.

Using Technological Design
- Propose or critique solutions to problems given criteria and scientific constraints.
- Identify scientific tradeoffs in design decisions and choose among alternative solutions.
- Apply science principles or data to anticipate effects of technological design decisions.

The Framework Practices

Practice 1. Asking Questions and Defining Problems

Practice 2. Developing and Using Models

Practice 3. Planning and Carrying Out Investigations

Practice 4. Analyzing and Interpreting Data

Practice 5. Using Mathematics and Computational Thinking

Practice 6. Constructing Explanations and Designing Solutions

Practice 7. Engaging in Argument from Evidence

Practice 8. Obtaining, Evaluating, and Communicating Information

Aaron Rogat. Computer-Based Performance Assessments from NAEP and ETS and their relationship to the NGSS. Educational Testing Service. http://elalp.cbalwiki.ets.org/Classes+of+literacy+activities

NAEP Science Practices

Four cognitive demands:

- Identifying Science Principles “knowing that”
- Using Scientific Inquiry “knowing how”
- Using Scientific Principles: “knowing why”
- Using Technological Design: (tasks or problems) “knowing when and where to apply knowledge”

NAEP 2009-2011 Science Framework

Using Scientific Inquiry

- Design or critique aspects of scientific investigations
- Conduct scientific investigations using appropriate tools and techniques
- Identify patterns in data and/or relate patterns in data to theoretical models.
- Use empirical evidence to validate or criticize conclusions about explanations and predictions

More complex than simply making, summarizing, and explaining observations, and it is more flexible than the rigid set of steps often referred to as the "scientific method."

The National Standards make it clear that inquiry goes beyond "science as a process" to include an understanding of the nature of science (p. 105)

Using Scientific Inquiry draws heavily on procedural knowledge ("knowing how")

NAEP 2009-2011 Science Framework

Using Technological Design

- Propose or critique solutions to problems, given criteria and scientific constraints.
- Identify scientific tradeoffs in design decisions and choose among alternative solutions.
- Apply science principles or data to anticipate effects of technological design decisions.

Earth and Space Science SCR: Gr.4 2009: difficulty: medium

Explain choice of material based on protection of the environment
When people buy groceries, they may have their groceries packed in plastic bags, paper bags, or cloth bags they bring with them.
Which type of grocery bag is best to use to help protect the environment?

1. Plastic
2. Paper
3. Cloth

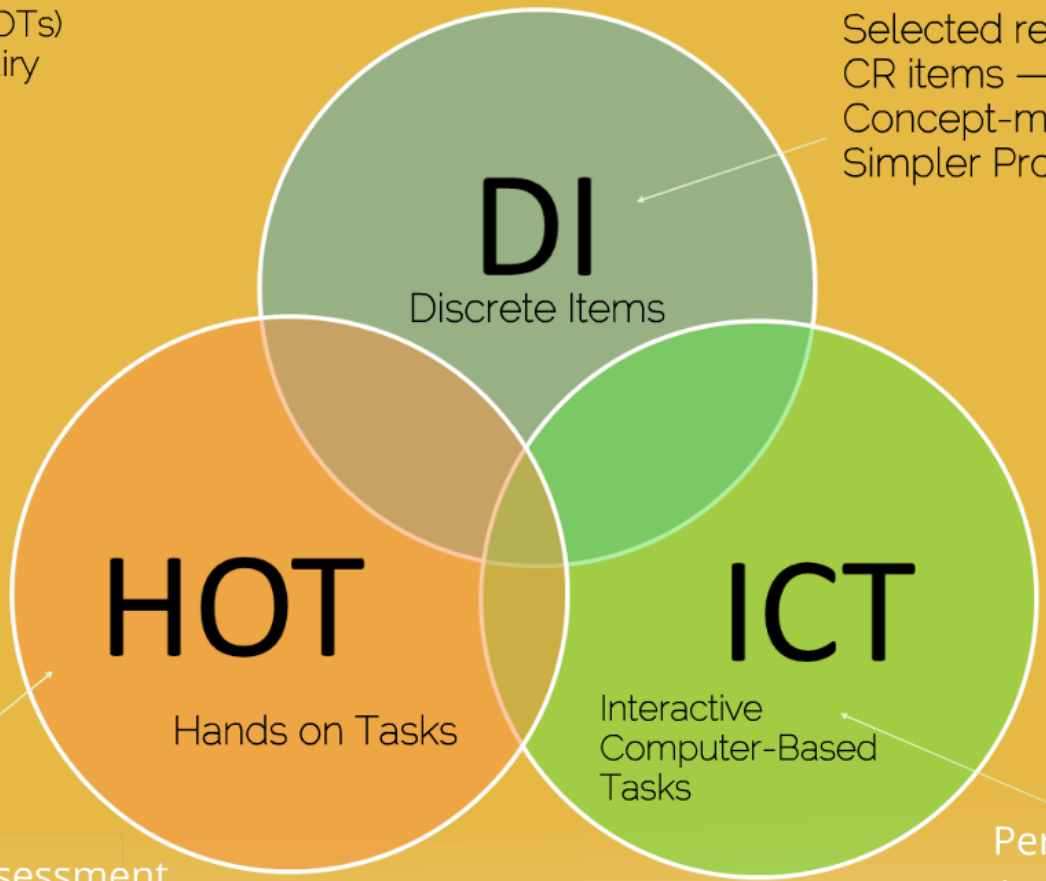
Explain why your choice helps protect the environment.

NAEP 2009-2011 Science Framework

Task Types in NAEP Science

Item Examples:

- Interactive Computer Tasks (ICTs)
- Hands-On Tasks (HOTs)
- Using Scientific Inquiry
- NQT



Selected response (MC)
CR items — Short CR: Extended CR:
Concept-mapping tasks
Simpler Processes or Tasks

Performance Based Assessment
Predict-Observe-Explain (POE)
More Complex Processes or Tasks

Performance Based
Assessment
More Complex Processes
or Tasks

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Subcomponents of Science Inquiry

P1. Ability to pose preliminary ideas

P1.A. Ability to pose preliminary testable questions

P1.B. Ability to pose preliminary explanations, models, or theories based on previously learned observations or science principles

P1.C. Ability to make preliminary predictions based on previously learned observations or science principles

P1.D. Ability to communicate or represent questions, explanations, models, or predictions

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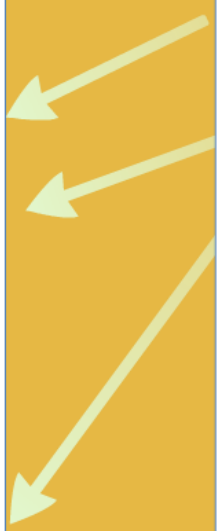
Comparison to NGSS Practices

Science Inquiry Competency Model	NGSS
P1. Ability to pose preliminary ideas	Practice 1. Asking Questions and Defining Problems
P1.A pose preliminary testable questions	Practice 2. Developing and Using Models
P1.B. pose preliminary explanations, models, or theories based on previously learned observations or science principles	Practice 8. Obtaining, Evaluating, and Communicating Information
P1.C. make preliminary predictions based on previously learned observations or science principles	
P1.D. communicate or represent questions, explanations, models, or predictions	



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Subcomponents of Science Inquiry

P2. Ability to design or critique investigations

P2.A. Ability to identify variables

P2.B. Ability to identify or construct hypotheses

P2.C. Ability to design an investigation (e.g., a fair test)

P2.D. Ability to critique a design of an investigation (e.g., a fair test)

P2.E. Ability to communicate (written, oral, or graphic) a design of a scientific investigation

P2.F. Ability to communicate (written, oral, or graphic) a critique of a scientific investigation

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Comparison to NGSS Practices

Science Inquiry Competency Model

P2. Ability to design or critique investigations

P2.A. Ability to identify variables

P2.B. Ability to identify or construct hypotheses

P2.C. design an investigation

P2.D. critique a design of an investigation

P2.E. communicate a design of a scientific investigation

P2.F. communicate a critique of a scientific investigation

NGSS

Practice 3 Planning and Carrying Out Investigations

Practice 8 Obtaining, Evaluating, and Communicating Information

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Subcomponents of Science Inquiry

P3. Ability to conduct investigations

P3.A. Ability to select appropriate tools and techniques

P3.B. Ability to use appropriate tools and techniques

P3.C. Ability to implement appropriate data collection procedures

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Comparison to NGSS Practices

Science Inquiry Competency Model

P3. Ability to conduct investigations

P3.A. select appropriate tools and techniques

P3.B. use appropriate tools and techniques

NGSS

Practice 3 Planning and Carrying Out Investigations

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Subcomponents of Science Inquiry

P4. Ability to interpret data and relate patterns to theoretical models

P4.A. Ability to represent data (including transforming or re-representing data) to detect patterns…

P4.B. Ability to identify patterns in quantitative data (e.g., in tables, graphs)

P4.C. Ability to relate patterns in quantitative data (e.g., in tables, graphs) to a hypothesis, theory, model, explanation, or an accepted scientific principle

P4.D. Ability to identify patterns in qualitative data (e.g., observations in physical phenomena, maps, pictures, drawings, etc.).

P4.E. Ability to relate patterns in qualitative data (e.g., observations in physical phenomena, maps, pictures, drawings, etc.) to a hypothesis, theory, model, or an accepted scientific principle

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from NAEP and ETS and their relationship to the NGSS. Educational Testing Service.
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Comparison to NGSS Practices

Science Inquiry Competency Model

P4. Ability to interpret data and relate patterns to theoretical models

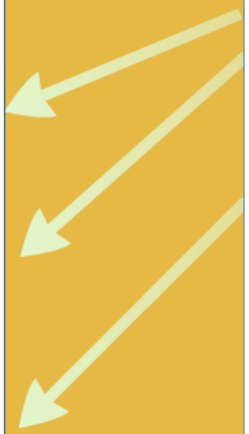
P4.A. represent data (including transforming or re-representing data)

P4.B. identify patterns in quantitative data

P4.C. relate patterns in quantitative data

P4.D. identify patterns in qualitative data

P4.E. relate patterns in qualitative data



NGSS

Practice 4 Analyzing and Interpreting Data

Practice 5 Using Mathematics and Computational Thinking (additional KSA for P4 in task templates, e.g. not a focus, but is accounted for in task)

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Subcomponents of Science Inquiry

P5. Ability to use evidence to make conclusions

P5.A. Ability to use evidence to support/construct an explanation

P5.B. Ability to use evidence to revise or refine theories or models

P5.C. Ability to use evidence to critique explanations, theories, or models

P5.D. Ability to use evidence to validate predictions

P5.E. Ability to use evidence to critique predictions

P5.F. Ability to communicate a conclusion from a scientific investigation

P5.G. Ability to communicate a critique of a conclusion from a scientific investigation

Aaron Rogat. Computer-Based Performance Assessments from NAEP and ETS and their relationship to the NGSS. Educational Testing Service. http://elalp.cbalwiki.ets.org/Classes+of+literacy+activities

Comparison to NGSS Practices

Science Inquiry Competency Model

P5. Ability to use evidence to make conclusions

P5.A. use evidence to support or construct an explanation

P5.B. use evidence to revise or refine theories or models

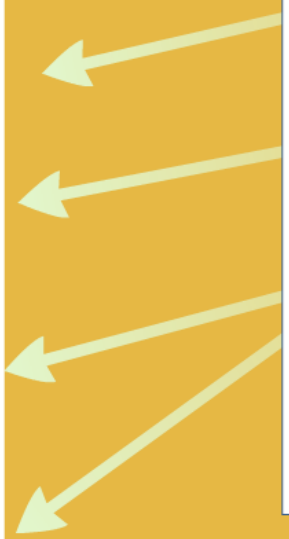
P5.C. evidence to critique explanations, theories, or models

P5.D. use evidence to validate predictions

P5.E. use evidence to critique predictions

P5.F. communicate a conclusion from a scientific investigation

P5.G. communicate a critique of a conclusion from a scientific investigation



NGSS

Practice 6 Constructing Explanations and Designing Solutions

Practice 7 Engaging in Argument from Evidence

Practice 8 Obtaining, Evaluating, and Communicating Information

Aaron Rogat. Computer-Based Performance Assessments from NAEP and ETS and their relationship to the NGSS. Educational Testing

Generating Performance Expectations

Exhibit 14. Generating examples of grade 8 performance expectations

Science Practices	Science Content: Physical Science Content Statements	Science Content: Life Science Content Statements	Science Content: Earth and Space Sciences Content Statements
Identifying Science Principles	Identify the units that might be used to measure the speed of an ant and the speed of an airplane (see **P8.14**).*	Identify the raw materials that plants use to make sugars (see **L8.4**).	Identify wind as the movement of air from higher to lower pressure regions (see **E8.11**).
Using Science Principles	An object (e.g., a toy car) moves with a constant speed along a straight line. Predict (with justification) what might happen to this object's speed as it rolls downhill (see **P8.16**).	Explain why sugars are found to move primarily down the stem of a growing plant (e.g., potato, carrot) (see **L8.4**).	Explain why mountain soils are generally thinner than floodplain soils (see **E8.6**).
Using Scientific Inquiry	Design an experiment to determine how the speed of a battery-operated toy car changes as a result of added mass (see **P8.16**).	Criticize conclusions about likely consequences of consuming various diets based on flawed premises or flaws in reasoning (see **L8.5**).	Given data (indexed by month) on annual trends of incoming solar radiation for five cities, determine whether the location is in the Northern or Southern Hemisphere (see **E8.12**).
Using Technological Design	Evaluate the following car designs to determine which one is most likely to maintain a constant speed as it goes down a hill (see **P8.16**).	Identify possible ecological side effects of agricultural fertilizer runoff into a lake (see **L8.7**).	Describe the consequences (e.g., erosion) of undercutting a steep slope for a road cut (see **E8.4**).

* To identify the science content statement on which each performance expectation is based, the content statement's unique code (from exhibits 8, 10, and 12 in chapter two) is provided.

NAEP 2009-2011 Science Framework

"For NAEP, "proficient" represents an aspirational goal for what student should know and be able to do, while on most state tests, it describes the level of student performance that is good enough to be regarded as acceptable for a particular grade level"

– Chudowsky 2010

NAEP SCIENCE ACHIEVEMENT LEVEL DESCRIPTIONS for GRADE 8

Should be able to...

Basic (141)

- state or recognize correct science principles;
- explain and predict observations of natural phenomena at multiple scales, from microscopic to global, using evidence to support their explanations and predictions;
- design investigations employing appropriate tools for measuring variables;
- propose and critique the scientific validity of alternative individual and local community responses to design problems.

Proficient (170)

- demonstrate relationships among closely related science principles;
- explain and predict observations of phenomena at multiple scales, from microscopic to macroscopic and local to global, and to suggest examples of observations that illustrate a science principle;
- design investigations requiring control of variables to test a simple model, employing appropriate sampling techniques and data quality review processes, and use the evidence to communicate an argument that accepts, revises, or rejects the model;
- propose and critique solutions and predict the scientific validity of alternative individual and local community responses to design problems.

Advanced (215)

- demonstrate relationships among different representations of science principles.
- explain and predict observations of phenomena at multiple scales, from microscopic to macroscopic and local to global, and develop alternative explanations of observations, using evidence to support their thinking.
- design control of variable investigations employing appropriate sampling techniques and data quality review processes that strengthen the evidence used to argue for one alternate model over another.
- propose and critique alternative solutions that reflect science-based trade-offs for addressing local and regional problems.

NAEP 2011 Science Framework: www.nces.ed.gov

LEVEL DESCRIPTIONS for GRADE 8

Should be able to...

Basic (141)

- state or recognize correct science principles;
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Proficient (170)

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- explain and predict observations of phenomena at multiple scales, from microscopic to macroscopic and local to global, and to suggest examples of observations that illustrate a science principle;
- design investigations requiring control of variables to test a simple model, employing appropriate sampling techniques and data quality review processes, and use the evidence to communicate an argument that accepts, revises, or rejects the model;
- propose and critique solutions and predict the scientific validity of alternative individual and local community responses to design problems.

Advanced (215)

- demonstrate relationships among different representations of science principles.
- explain and predict observations of phenomena at multiple scales, from microscopic to macroscopic and local to global, and develop alternative explanations of observations, using evidence to support their thinking.
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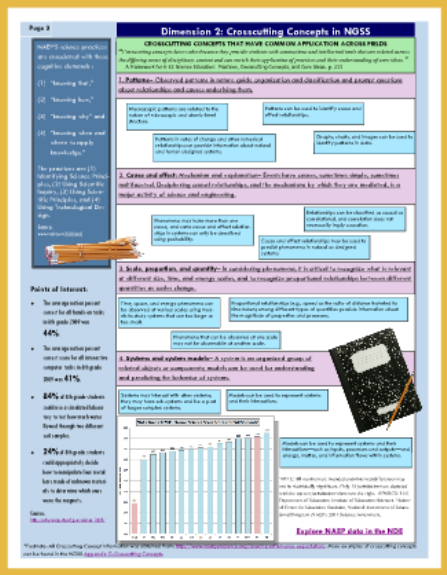
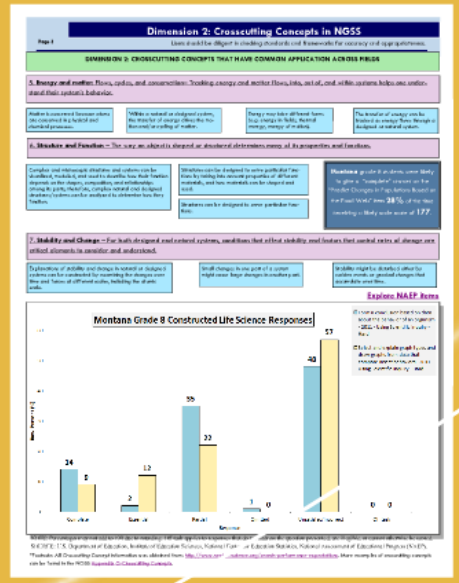
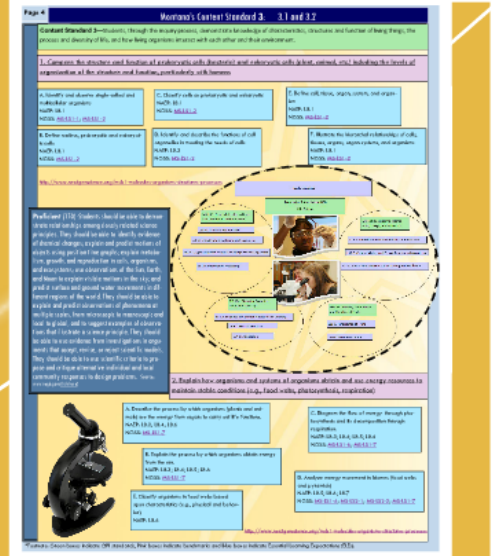
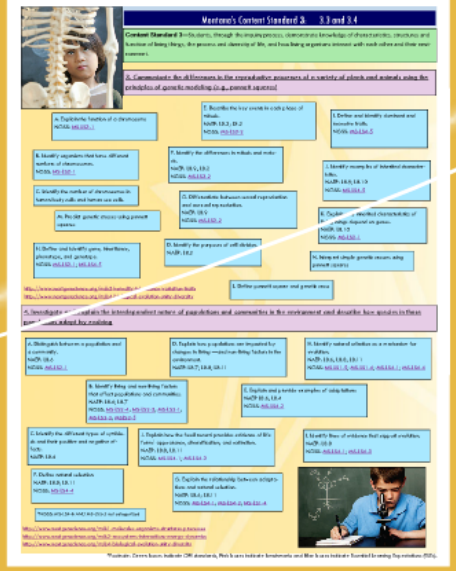
NAEP 2011 Science Framework: www.nces.ed.gov

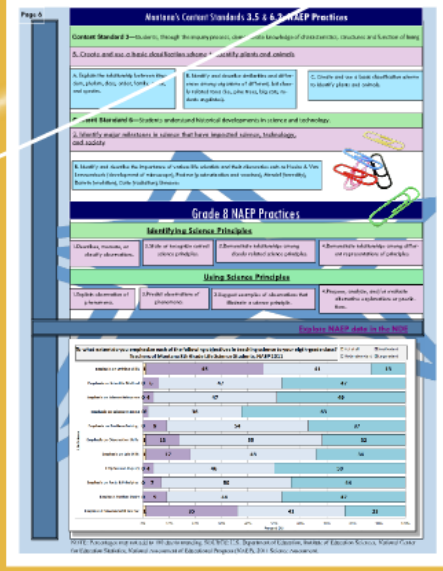
Closer Look at standards

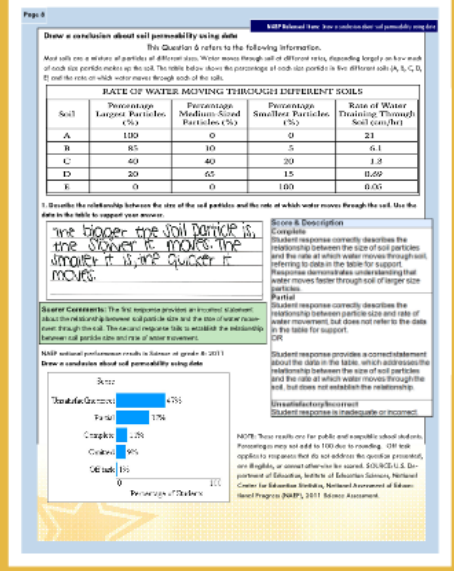










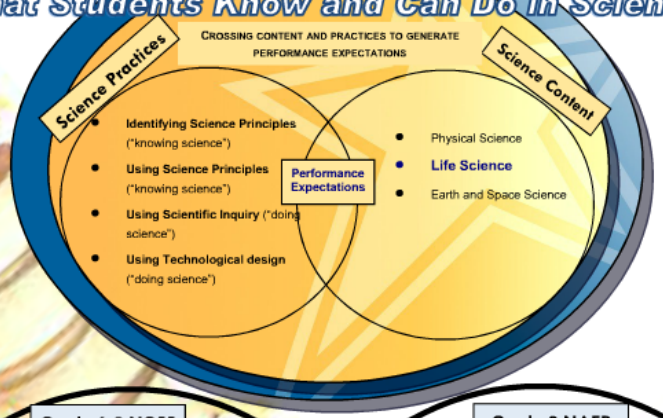


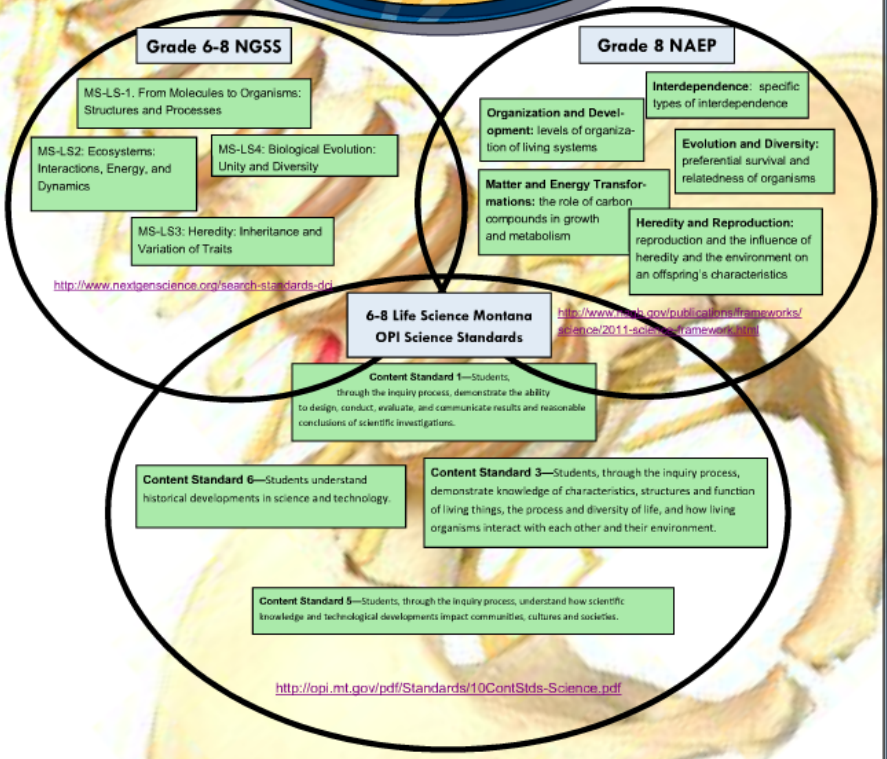
6-8 LIFE SCIENCE

October 2013 Volume 1, Issue 1

Inside this issue:

NAEP Science Assessment
What Students Know and Can Do in Science





This brochure is the creation of Ashley McGrath Montana's NAEP State Coordinator, users should be diligent in checking standards and frameworks for accuracy and appropriateness. For questions, please contact amgrath@mt.gov.

NAEP'S science practices are associated with these cognitive demands :

(1) "knowing that,"

(2) "knowing how,"

(3) "knowing why" and

(4) "knowing when and where to apply knowledge."

The practices are (1) Identifying Science Principles, (2) Using Scientific Inquiry, (3) Using Scientific Principles, and (4) Using Technological Design.

Source:
www.nagb.gov (click here)

Points of Interest:

- The average nation percent correct for all hands-on tasks in 8th grade 2009 was **44%**.
- The average nation percent correct score for all interactive computer tasks in 8th grade 2009 was **41%**.
- **84%** of 8th grade students could use a simulated laboratory to test how much water flowed through two different soil samples.
- **24%** of 8th grade students could appropriately decide how to manipulate four metal bars made of unknown materials to determine which ones were the magnets.

Source:
http://nationsreportcard.gov/science_2009/

*Footnote: All Crosscutting Concept information can be found in the NGSS Appendix G-Crosscut

NCE

October 2013 Volume 1, Issue 1

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Do in Science

Science Content

al Science

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nd Space Science

Grade 8 NAEP

Interdependence: specific types of interdependence

d Devel- of organiza- ems

Evolution and Diversity: preferential survival and relatedness of organisms

gy Transfor- e of carbon owth

Heredity and Reproduction: reproduction and the influence of heredity and the environment on an offspring's characteristics

://www.nagb.gov/publications/frameworks/ence/2011-science-framework.html

ents, through the inquiry process, aracteristics, structures and function d diversity of life, and how living other and their environment.

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nce.pdf

na's NAEP State Coordinator, users rks for accuracy and appropriateness.

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Dimension 2: Crosscutting Concepts in NGSS

CROSSCUTTING CONCEPTS THAT HAVE COMMON APPLICATION ACROSS FIELDS

"*Crosscutting concepts have value because they provide students with connections and intellectual tools that are related across the differing areas of disciplinary content and can enrich their application of practices and their understanding of core ideas.*" — A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas. p. 233

1. **Patterns**– Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them.

- Macroscopic patterns are related to the nature of microscopic and atomic-level structure.
- Patterns can be used to identify cause and effect relationships.
- Patterns in rates of change and other numerical relationships can provide information about natural and human designed systems.
- Graphs, charts, and images can be used to identify patterns in data.

2. **Cause and effect:** Mechanism and explanation– Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.

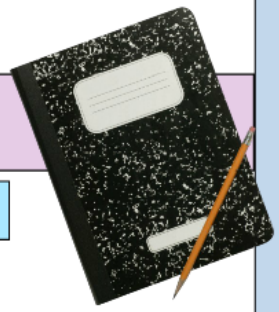
- Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
- Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation.
- Cause and effect relationships may be used to predict phenomena in natural or designed systems.

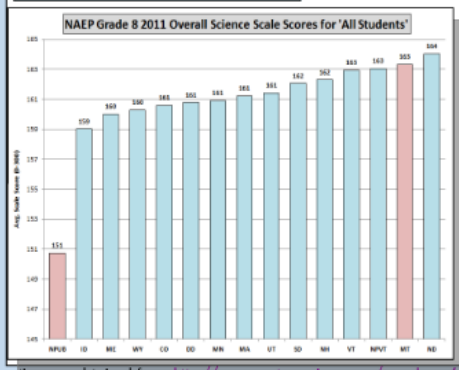
3. **Scale, proportion, and quantity**– In considering phenomena, it is critical to recognize what is relevant at different size, time, and energy scales, and to recognize proportional relationships between different quantities as scales change.

- Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.
- Proportional relationships (e.g., speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes.
- Phenomena that can be observed at one scale may not be observable at another scale.

4. **Systems and system models**– A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems.

- Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems.
- Models can be used to represent systems and their interactions.
- Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems.





NOTE: All numbers are rounded and observed differences may not be statistically significant. Only 15 jurisdictions are depicted with the top ten jurisdictions shown on the right. SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2011 Science Assessment.

Explore NAEP data in the NDE

*Footnote: All *Crosscutting Concept* information was obtained from: http://www.nextgenscience.org/search-performance-expectations. More examples of crosscutting concepts can be found in the NGSS Appendix G-Crosscutting Concepts.

DIMENSION 2:

5. **Energy and matter:** Flows, cycles stand their system's behavior.

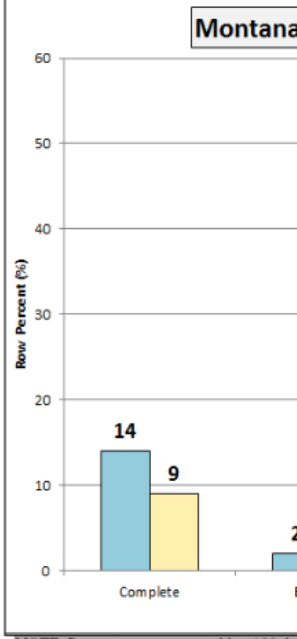
- Matter is conserved because atoms are conserved in physical and chemical processes.

6. **Structure and Function** – The wa

- Complex and microscopic structures and syst visualized, modeled, and used to describe h depends on the shapes, composition, and rel among its parts; therefore, complex natural structures/systems can be analyzed to deter function.

7. **Stability and Change** – For both critical elements to consider and un

- Explanations of stability and change in natu systems can be constructed by examining th time and forces at different scales, including scale.



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Dimension 2: Crosscutting Concepts in NGSS

Users should be diligent in checking standards and frameworks for accuracy and appropriateness.

DIMENSION 2: CROSSCUTTING CONCEPTS THAT HAVE COMMON APPLICATION ACROSS FIELDS

5. **Energy and matter:** Flows, cycles, and conservation– Tracking energy and matter flows, into, out of, and within systems helps one understand their system's behavior.

- Matter is conserved because atoms are conserved in physical and chemical processes.
- Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter.
- Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion).
- The transfer of energy can be tracked as energy flows through a designed or natural system.

6. **Structure and Function** – The way an object is shaped or structured determines many of its properties and functions.

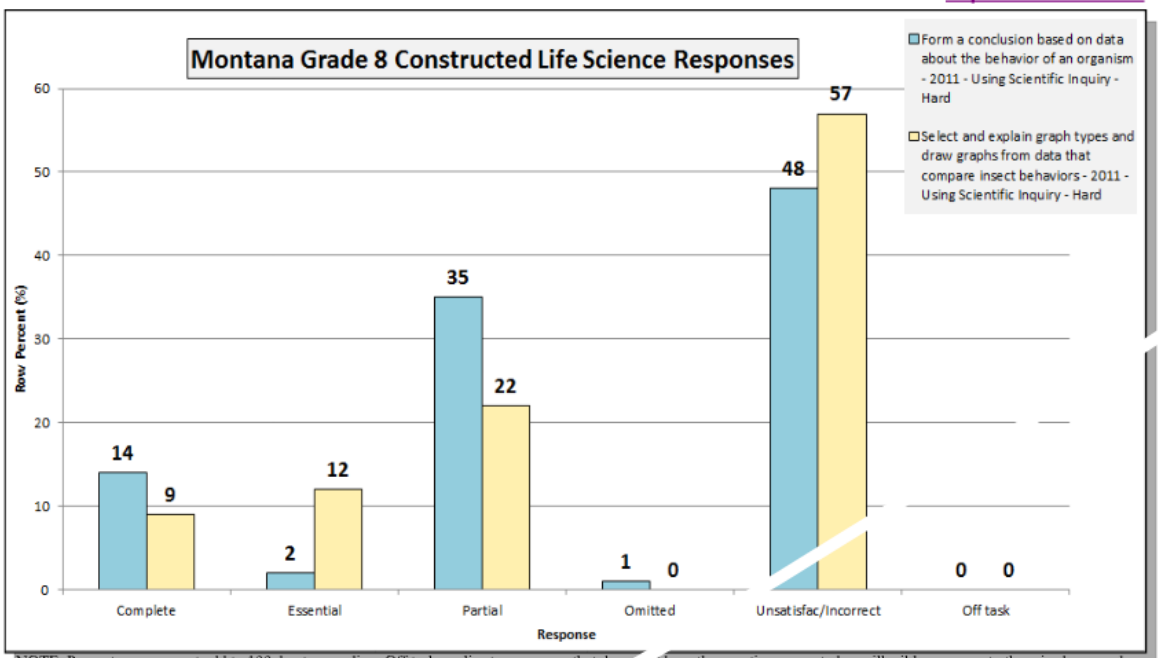
- Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts; therefore, complex natural and designed structures/systems can be analyzed to determine how they function.
- Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.
- Structures can be designed to serve particular functions.

Montana grade 8 students were likely to give a "complete" answer on the "Predict Changes in Populations Based on the Food Web" item **28%** of the time receiving a likely scale score of **177**.

7. **Stability and Change** – For both designed and natural systems, conditions that affect stability and factors that control rates of change are critical elements to consider and understand.

- Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales, including the atomic scale.
- Small changes in one part of a system might cause large changes in another part.
- Stability might be disturbed either by sudden events or gradual changes that accumulate over time.

Explore NAEP items



NOTE: Percentages may not add to 100 due to rounding. Off task applies to responses that do not address the question presented, are illegible, or cannot otherwise be scored. SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP).

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Content Standard 3—Students, throu process and diversity of life, and how livi

1. Compare the structure and functi organization of the structure and fu

A. Identify and observe single-celled and multicellular organisms
NAEP: L8.1
NGSS: MS-LS1-1; MS-LS1-2

B. Define nucleus, prokaryotic and eukaryot- ic cells
NAEP: L8.1
NGSS: MS-LS1-2

http://www.nextgenscience.org/msls1-mole

Proficient (170) -Students should be able t strate relationships among closely related principles. They should be able to identify e of chemical changes; explain and predict mo objects using position time graphs; explain lism, growth, and reproduction in cells, orga and ecosystems; use observations of the Su and Moon to explain visible motions in the predict surface and ground water movemen ferent regions of the world. They should be explain and predict observations of phenom multiple scales, from microscopic to macros local to global, and to suggest examples of tions that illustrate a science principle. They be able to use evidence from investigations ments that accept, revise, or reject scientifi They should be able to use scientific criteria pose and critique alternative individual and community responses to design problems. www.negb.gov (click here)

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*Footnote: Green boxes indicate OPI standards, Pl

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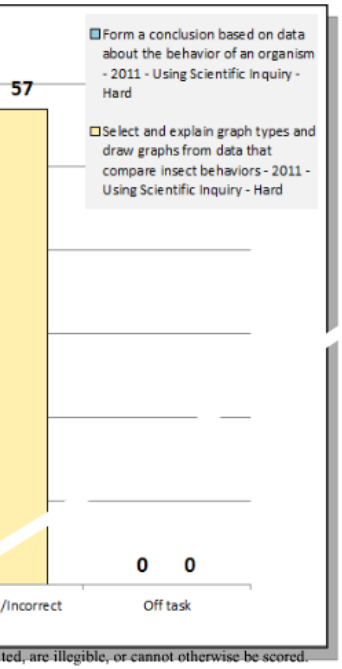

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Assessment of Educational Progress (NAEP).
ctations. More examples of crosscutting concepts

Montana's Content Standard 3: 3.1 and 3.2

Content Standard 3—Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

1. Compare the structure and function of prokaryotic cells (bacteria) and eukaryotic cells (plant, animal, etc.) including the levels of organization of the structure and function, particularly with humans

A. Identify and observe single-celled and multicellular organisms
NAEP: L8.1
NGSS: MS-LS1-1; MS-LS1-2

C. Classify cells as prokaryotic and eukaryotic
NAEP: L8.1
NGSS: MS-LS1-2

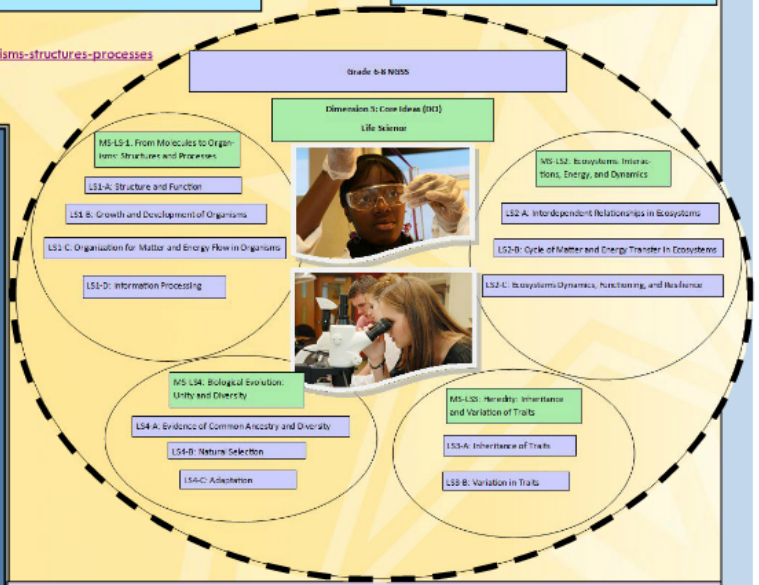
E. Define cell, tissue, organ, system, and organism
NAEP: L8.1
NGSS: MS-LS1-3

B. Define nucleus, prokaryotic and eukaryotic cells
NAEP: L8.1
NGSS: MS-LS1-2

D. Identify and describe the functions of cell organelles in meeting the needs of cells
NAEP: L8.3
NGSS: MS-LS1-2

F. Illustrate the hierarchal relationships of cells, tissues, organs, organ systems, and organisms
NAEP: L8.1
NGSS: MS-LS1-3

http://www.nextgenscience.org/msls1-molecules-organisms-structures-processes



Proficient (170) -Students should be able to demonstrate relationships among closely related science principles. They should be able to identify evidence of chemical changes; explain and predict motions of objects using position time graphs; explain metabolism, growth, and reproduction in cells, organisms, and ecosystems; use observations of the Sun, Earth, and Moon to explain visible motions in the sky; and predict surface and ground water movements in different regions of the world. They should be able to explain and predict observations of phenomena at multiple scales, from microscopic to macroscopic and local to global, and to suggest examples of observations that illustrate a science principle. They should be able to use evidence from investigations in arguments that accept, revise, or reject scientific models. They should be able to use scientific criteria to propose and critique alternative individual and local community responses to design problems. Source: www.mcgb.gov (click here)

2. Explain how organisms and systems of organisms obtain and use energy resources to maintain stable conditions (e.g., food webs, photosynthesis, respiration)

A. Describe the process by which organisms (plants and animals) use the energy from sugars to carry out life functions.
NAEP: L8.3; L8.4; L8.6
NGSS: MS-LS1-7

C. Diagram the flow of energy through photosynthesis and its decomposition through respiration.
NAEP: L8.3; L8.4; L8.5; L8.6
NGSS: MS-LS1-6; MS-LS1-7

B. Explain the process by which organisms obtain energy from the sun.
NAEP: L8.3; L8.4; L8.5; L8.6
NGSS: MS-LS1-7

D. Analyze energy movement in biomes (food webs and pyramids)
NAEP: L8.5; L8.6; L8.7
NGSS: MS-LS1-6; MS-LS2-1; MS-LS2-3; MS-LS1-7

E. Classify organisms in food webs based upon characteristics (e.g., physical and behavior)
NAEP: L8.6

http://www.nextgenscience.org/msls1-molecules-organisms-structures-processes

*Footnote: Green boxes indicate OPI standards, Pink boxes indicate benchmarks and Blue boxes indicate Essential Learning Expectations (ELEs).

Montana's Content Standard 3: 3.3 and 3.4

Content Standard 3—Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

3. Communicate the differences in the reproductive processes of a variety of plants and animals using the principles of genetic modeling (e.g., punnett squares)

A. Explain the function of a chromosome
NGSS: MS-LS3-1

B. Identify organisms that have different numbers of chromosomes.
NGSS: MS-LS3-1

C. Identify the number of chromosomes in human body cells and human sex cells.

M. Predict genetic crosses using punnett squares

H. Define and identify gene, inheritance, phenotype, and genotype.
NGSS: MS-LS3-1; MS-LS4-5

E. Describe the key events in each phase of mitosis.
NAEP: L8.3; L8.2
NGSS: MS-LS3-2

F. Identify the differences in mitosis and meiosis.
NAEP: L8.9; L8.2
NGSS: MS-LS3-2

G. Differentiate between sexual reproduction and asexual reproduction.
NAEP: L8.9
NGSS: MS-LS3-2

D. Identify the purposes of cell division.
NAEP: L8.2

I. Define and identify dominant and recessive traits.
NGSS: MS-LS4-5

J. Identify examples of inherited characteristics.
NAEP: L8.9; L8.10
NGSS: MS-LS4-5

K. Explain ... inherited characteristics of ... nings depend on genes.
NAEP: L8.10
NGSS: MS-LS3-1

N. Interpret simple genetic crosses using punnett squares

L. Define punnett square and genetic cross

http://www.nextgenscience.org/msls3-heredity-in... ...nce-variation-traits
http://www.nextgenscience.org/msls4-... ...gical-evolution-unity-diversity

4. Investigate ... explain the interdependent nature of populations and communities in the environment and describe how species in these pop... ...ons adapt by evolving

A. Distinguish between a population and a community.
NAEP: L8.6
NGSS: MS-LS2-1

B. Identify living and non-living factors that effect populations and communities.
NAEP: L8.4; L8.7
NGSS: MS-LS2-4; MS-LS2-3; MS-LS2-1; MS-LS2-2; MSLS2-5

C. Identify the different types of symbiosis and their positive and negative effects.
NAEP: L8.6

F. Define natural selection
NAEP: L8.8; L8.11
NGSS: MS-LS4-4

*NGSS: MS-LS4-6 AND MS-LS2-5 not categorized

D. Explain how populations are impacted by changes in living —and non-living factors in the environment.
NAEP: L8.7; L8.8; L8.11

E. Explain and provide examples of adaptations
NAEP L8.6; L8.4
NGSS: MS-LS4-2

J. Explain how the fossil record provides evidence of life forms' appearance, diversification, and extinction.
NAEP: L8.8; L8.11
NGSS: MS-LS4-1; MS-LS4-3

G. Explain the relationship between adaptations and natural selection.
NAEP: L8.6; L8.11
NGSS: MS-LS4-1; MS-LS4-2; MS-LS1-4

H. Identify natural selection as a mechanism for evolution.
NAEP: L8.6; L8.8; L8.11
NGSS: MS-LS1-5; MS-LS1-4; MS-LS4-1; MS-LS4-4

I. Identify lines of evidence that support evolution.
NAEP: L8.8
NGSS: MS-LS4-1; MS-LS4-3

http://www.nextgenscience.org/msls1-molecules-organisms-structures-processes
http://www.nextgenscience.org/msls2-ecosystems-interactions-energy-dynamics
http://www.nextgenscience.org/msls4-biological-evolution-unity-diversity

*Footnote: Green boxes indicate OPI standards, Pink boxes indicate benchmarks and Blue boxes indicate Essential Learning Expectations (ELEs).

Content Standard

5. Create and use

A. Explain the relation... dom, phylum, class, or... and species.

Content Standar...

2. Identify major ... and society

B. Identify and descr... Leeuwenhoek (develo... Darwin (evolution), C...

1.Describes, measure, ... classify observa...

1.Explain observation ... phenomena.

To what extent do y...

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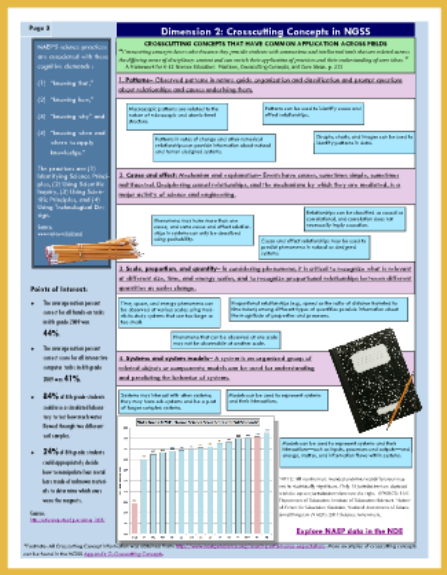
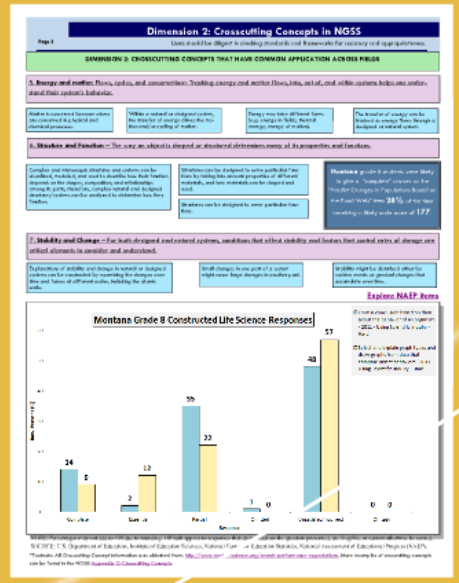
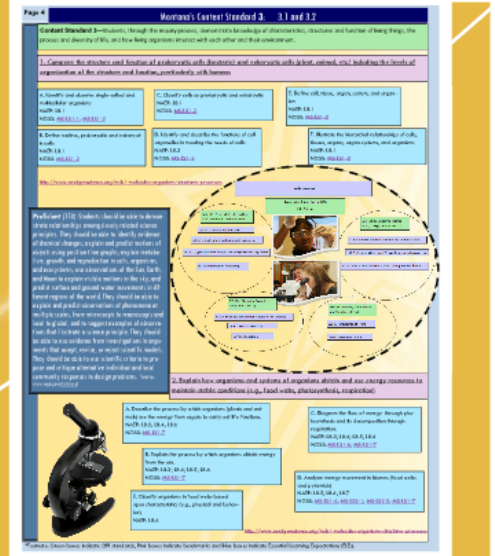
Life Science

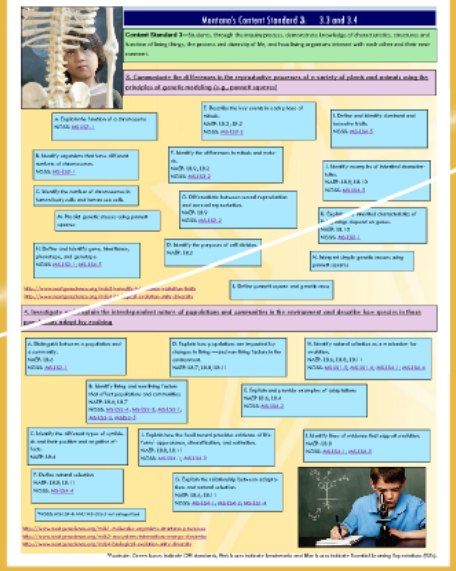
NOTE: Percentages m... for Education Statistic...

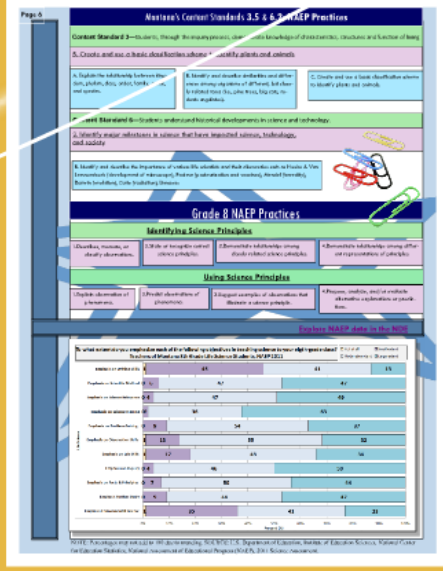
Closer Look at standards

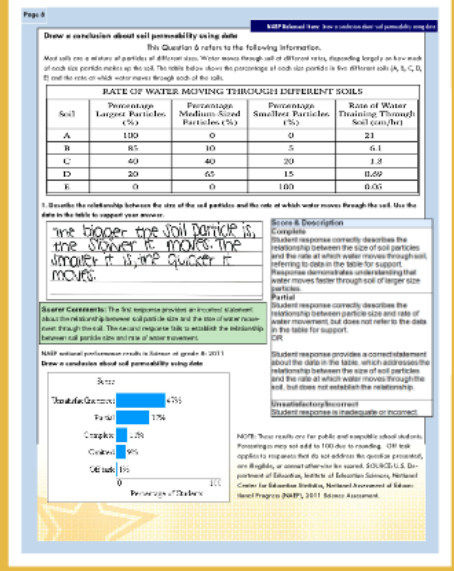




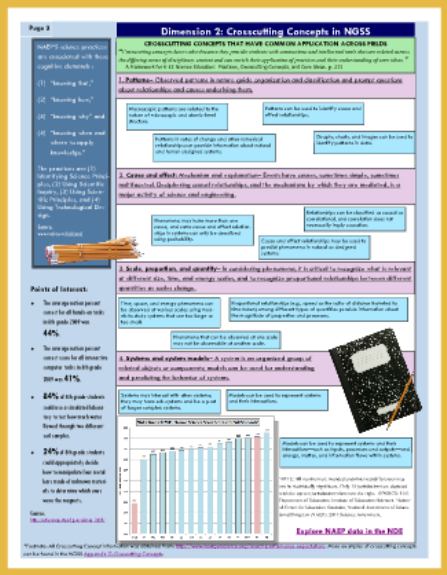


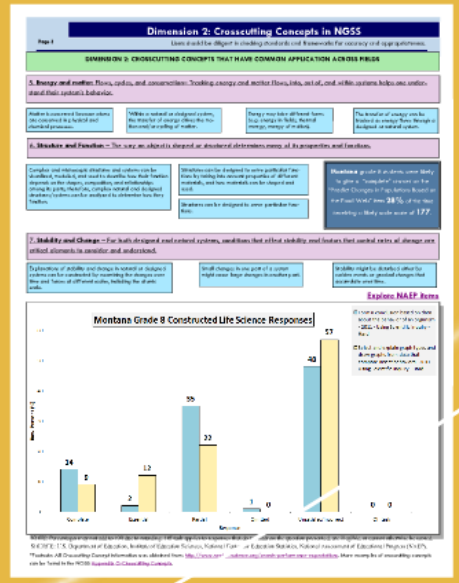


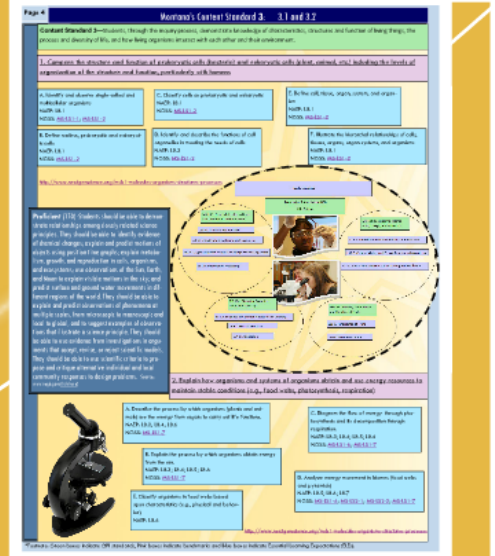


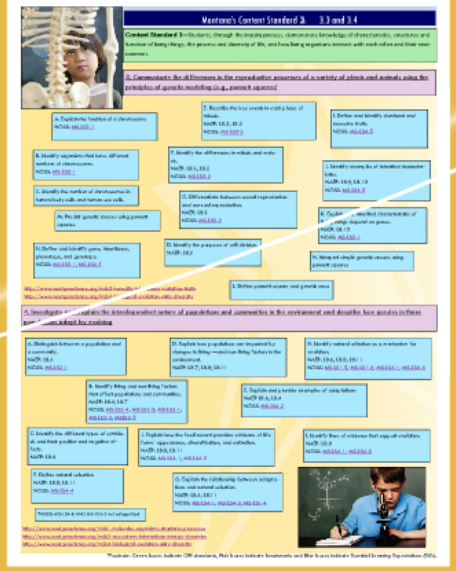


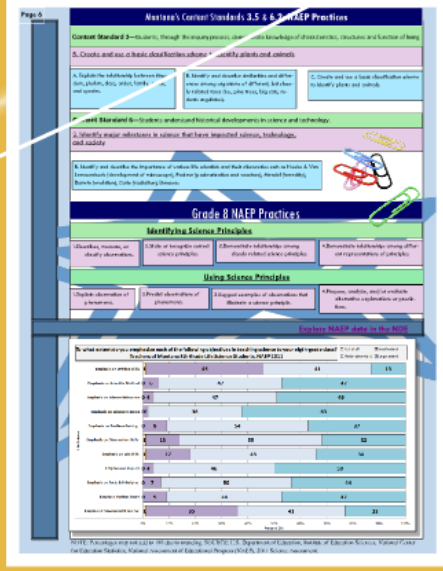
Closer Look at standards

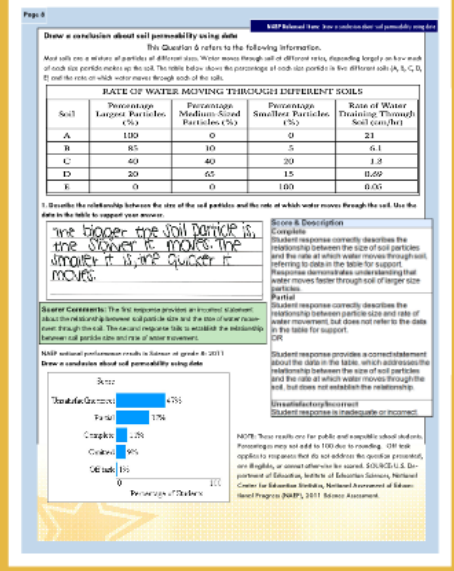












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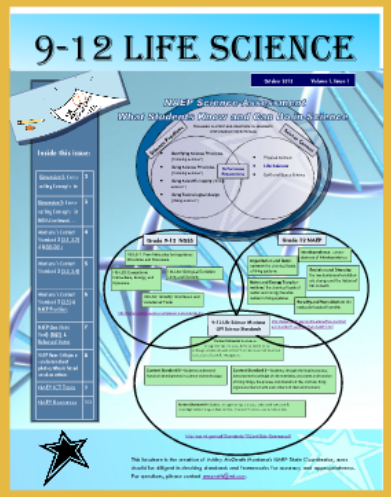
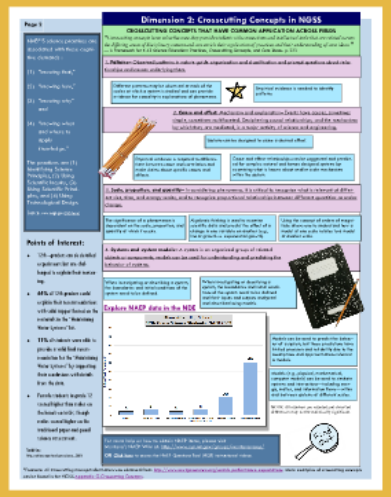
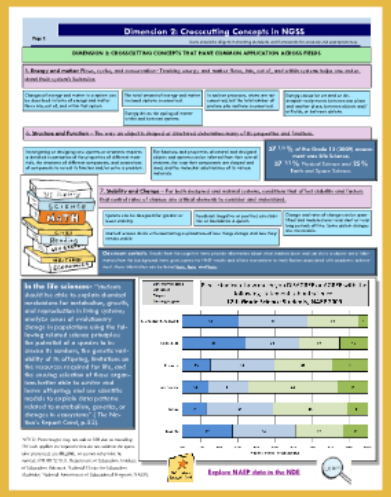
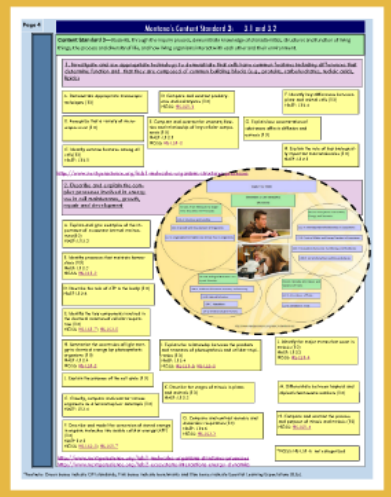
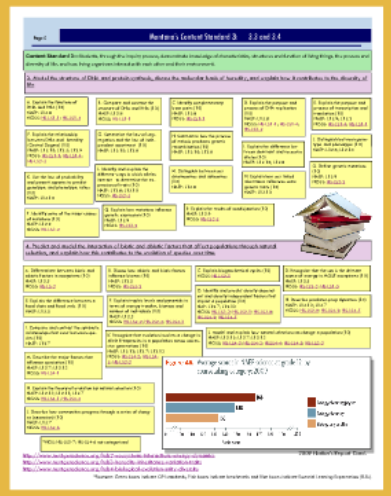
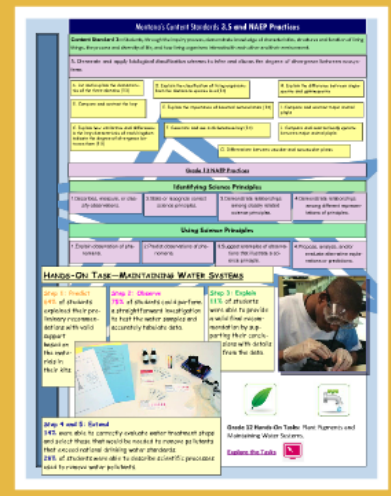


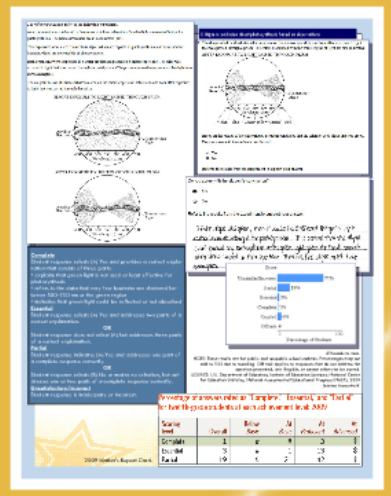










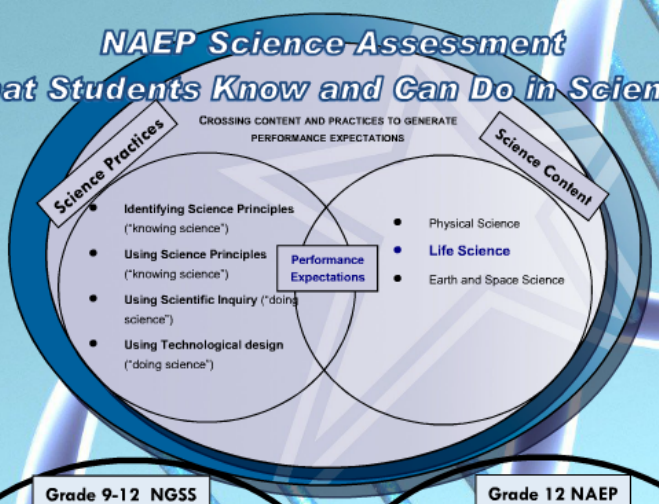


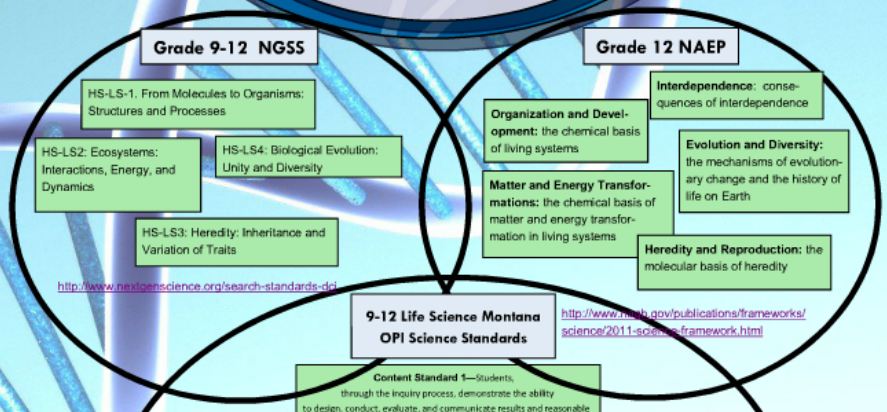
9-12 LIFE SCIENCE

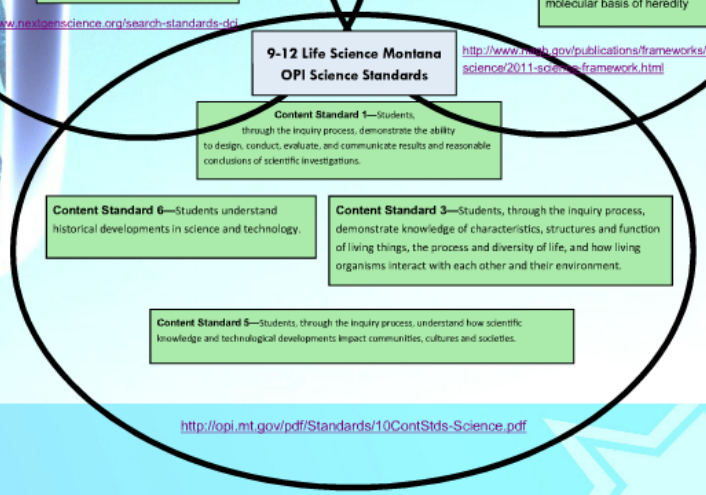
October 2013 Volume 1, Issue 1

Inside this issue:

NAEP Science Assessment
What Students Know and Can Do in Science







This brochure is the creation of Ashley McGrath Montana's NAEP State Coordinator, users should be diligent in checking standards and frameworks for accuracy and appropriateness. For questions, please contact amgrath@mt.gov.

NAEP'S science p
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Source: www.nagb.gov (c

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- Female student
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Source:
http://nationsreportcard.gov/sc

*Footnote: All Crosscut
can be found in the NG

Dimension 2: Crosscutting Concepts in NGSS

Users should be diligent in checking standards and frameworks for accuracy and appropriateness.

DIMENSION 2: CROSSCUTTING CONCEPTS THAT HAVE COMMON APPLICATION ACROSS FIELDS

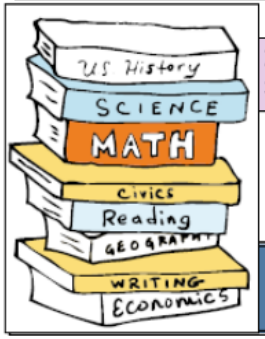
5. Energy and matter: Flows, cycles, and conservation– Tracking energy and matter flows, into, out of, and within systems helps one understand their system's behavior.

- Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.
- The total amount of energy and matter in closed systems is conserved.
- Energy drives the cycling of matter within and between systems.
- In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.
- Energy cannot be created or destroyed—only moves between one place and another place, between objects and/or fields, or between systems.

6. Structure and Function – The way an object is shaped or structured determines many of its properties and functions.

- Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.
- The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials.

37 1/2 % of the Grade 12 (2009) assessment was Life Science,
37 1/2 % Physical Science and **25%** Earth and Space Science.

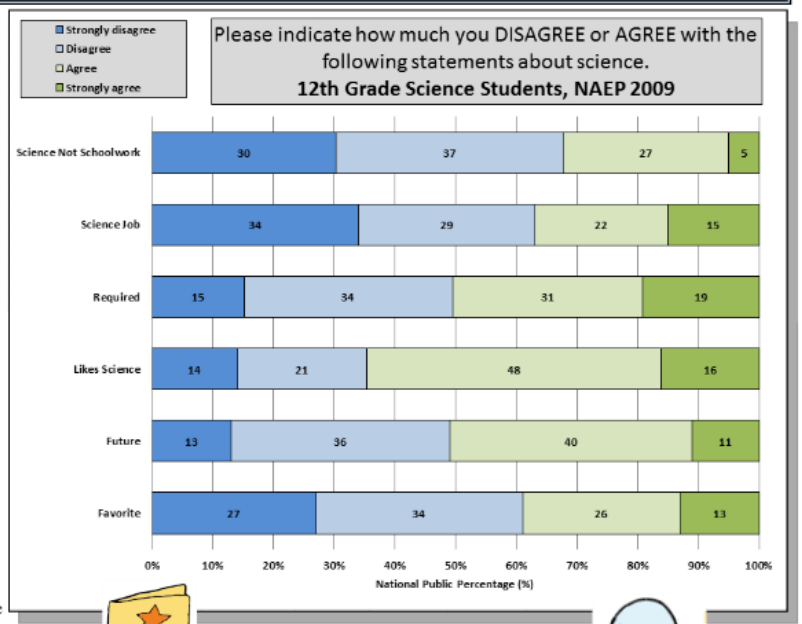


7. Stability and Change – For both designed and natural systems, conditions that affect stability and factors that control rates of change are critical elements to consider and understand.

- Systems can be designed for greater or lesser stability.
- Feedback (negative or positive) can stabilize or destabilize a system.
- Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.
- Much of science deals with constructing explanations of how things change and how they remain stable.

Classroom contexts. Results from the cognitive items provide information about what students *know* and *can do* in a subject area. Information from the background items gives context to NAEP results and allows researchers to track factors associated with academic achievement. More information can be found here, here and here.

In the life sciences- "students should be able to explain chemical mechanisms for metabolism, growth, and reproduction in living systems; analyze cases of evolutionary change in populations using the following related science principles: the potential of a species to increase its numbers, the genetic variability of its offspring, limitations on the resources required for life, and the ensuing selection of those organisms better able to survive and leave offspring; and use scientific models to explain data patterns related to metabolism, genetics, or changes in ecosystems" (The Nation's Report Card, p.52).



NOTE: Percentages may not add to 100 due to rounding. Off task applies to responses that do not address the question presented, are illegible, or cannot otherwise be scored. SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP).

Explore NAEP data in the NDE

Montana's Content Standard 3: 3.1 and 3.2

Content Standard 3—Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

1. Investigate and use appropriate technology to demonstrate that cells have common features including differences that determine function and that they are composed of common building blocks (e.g., proteins, carbohydrates, nucleic acids, lipids)

A. Demonstrate appropriate microscopic techniques (10)

D. Compare and contrast prokaryotes and eukaryotes (10)
NGSS: HS-LS1-2

F. Identify key differences between plant and animal cells (10)
NAEP: L12.4

B. Recognize that a variety of microscopes exist (10)

E. Compare and contrast the structure, function and relationship of key cellular components (10)
NAEP: L12.1
NGSS: HS-LS1-2

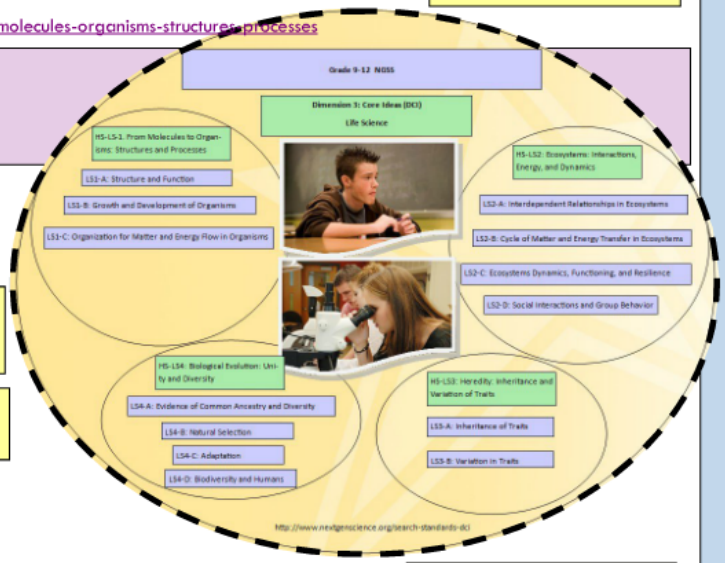
G. Explain how concentration of substances affects diffusion and osmosis (10)

C. Identify common features among all cells(10)
NAEP: L12.1

H. Explain the role of key biologically important macromolecules (10)
NAEP: L12.1

http://www.nextgenscience.org/hsls1-molecules-organisms-structures-processes

2. Describe and explain the complex processes involved in energy use in cell maintenance, growth, repair and development



A. Explain and give examples of the importance of a constant internal environment(10)
NAEP: L12.3

B. Identify processes that maintain homeostasis (10)
NAEP: L12.3
NGSS: HS-LS1-3

D. Describe the role of ATP in the body (10)
NAEP L12.6

E. Identify the key components involved in the chemical reaction of cellular respiration (10)
NGSS: HS-LS1-7; HS-LS2-5

H. Summarize the conversion of light energy to chemical energy by photosynthetic organisms (10)
NAEP: L12.4
NGSS: HS-LS1-5

I. Explain the relationship between the products and reactants of photosynthesis and cellular respiration (10)
NAEP: L12.4
NGSS: HS-LS1-5; HS-LS2-5

L. Identify the major events that occur in meiosis (10)
NAEP: L12.3
NGSS: HS-LS1-4

J. Explain the purpose of the cell cycle (10)

K. Describe the stages of mitosis in plants and animals (10)
NAEP: L12.3

M. Differentiate between haploid and diploid chromosome numbers (10)

C. Classify, compare and contrast various organisms as a heterotroph or autotroph (10)
NAEP: L12.4

G. Compare and contrast aerobic and anaerobic respiration (10)
NAEP: L12.6
NGSS: HS-LS2-3

N. Compare and contrast the process and purpose of mitosis and meiosis (10)
NGSS: HS-LS1-4

F. Describe and model the conversion of stored energy in organic molecules into usable cellular energy (ATP) (10)
NAEP 12.1
NGSS: HS-LS2-5; HS-LS1-7

*NGSS: HS-LS1-6 not categorized

http://www.nextgenscience.org/hsls1-molecules-organisms-structures-processes
http://www.nextgenscience.org/hsls2-ecosystems-interactions-energy-dynamics

*Footnote: Green boxes indicate OPI standards, Pink boxes indicate benchmarks and Blue boxes indicate Essential Learning Expectations (ELEs).

Montana's Content Standard 3: 3.3 and 3.4

Content Standard 3—Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

3. Model the structure of DNA and protein synthesis, discuss the molecular basis of heredity, and explain how it contributes to the diversity of life

A. Explain the functions of DNA and RNA (10)
NAEP: L12.8
NGSS: HS-LS1-1; HS-LS1-4

B. Compare and contrast the structure of DNA and RNA (10)
NAEP: L12.8
NGSS: HS-LS1-1

C. Identify complementary base pairs (10)
NAEP: L12.8
NGSS: HS-LS1-1

D. Explain the purpose and process of DNA replication (10)
NAEP: L12.8
NGSS: HS-LS1-1; HS-LS1-4; HS-LS3-2

E. Explain the purpose and process of transcription and translation (10)
NAEP: L12.9; L12.2
NGSS: HS-LS1-4; HS-LS1-1

F. Explain the relationship between DNA and heredity (Central Dogma) (10)
NAEP: L12.10; L12.2; L12.9
NGSS: HS-LS1-1; HS-LS1-4; HS-LS3-2

G. Summarize the law of segregation and the law of independent assortment (10)
NAEP: L12.10; L12.8

H. Summarize how the process of meiosis produces genetic recombination (10)
NAEP: L12.10; L12.8

I. Explain the difference between dominant and recessive alleles (10)
NAEP: L12.10; L12.8

J. Distinguish between genotype and phenotype (10)
NAEP: L12.8; L12.10

K. Use the law of probability and punnett squares to predict genotypic and phenotypic ratios (10)
NAEP: L12.10

L. Identify and explain the different ways in which alleles interact to determine the expression of traits (10)
NAEP: L12.8; L12.10
NGSS: HS-LS3-2

M. Distinguish between sex chromosomes and autosomes (10)
NAEP: L12.8

N. Explain how sex linked inheritance influences some genetic traits (10)
NAEP: L12.10

O. Define genetic mutations (10)
NAEP: L12.9
NGSS: HS-LS3-2

P. Identify some of the major causes of mutations (10)
NAEP: L12.9
NGSS: HS-LS3-2

Q. Explain how mutations influence genetic expression (10)
NAEP: L12.9
NGSS: HS-LS3-2

R. Explain the results of nondisjunction (10)
NAEP: L12.9
NGSS: HS-LS3-2

4. Predict and model the interaction of biotic and abiotic factors that affect populations through natural selection, and explain how this contributes to the evolution of species over time

A. Differentiate between biotic and abiotic factors in ecosystems (10)
NAEP: L12.5
NGSS: HS-LS-3

B. Discuss how abiotic and biotic factors influence biomes (10)
NAEP: L12.5
NGSS: HS-LS2-2

C. Explain biogeochemical cycles (10)
NGSS: HS-LS2-5

D. Recognize that the sun is the ultimate source of energy in MOST ecosystems (10)
NAEP: L12.5
NGSS: HS-LS2-3; HS-LS1-5

E. Explain the difference between a food chain and food web. (10)
NAEP: L12.5

F. Explain trophic levels and pyramids in terms of energy transfer, biomass and number of individuals (10)
NAEP: L12.5
NGSS: HS-LS2-2; HS-LS2-4; HS-LS2-3

G. Identify and predict density dependent and density independent factors that impact a population (10)
NAP: L12.7; L12.13
NGSS: HS-LS3-3; HS-LS2-1; HS-LS2-8; HS-LS4-2; HS-LS4-5

H. Describe predator-prey dynamics (10)
NAEP: L12.13; L12.7
NGSS: HS-LS2-8; HS-LS4-2; HS-LS4-5

I. Compare and contrast the symbiotic relationships that exist between species (10)
NAEP: L12.7

K. Recognize that evolution involves a change in allele frequencies in a population across successive generations (10)
NAEP: L12.12; L12.7; L12.13
NGSS: HS-LS4-3; HS-LS4-2; HS-LS3-3

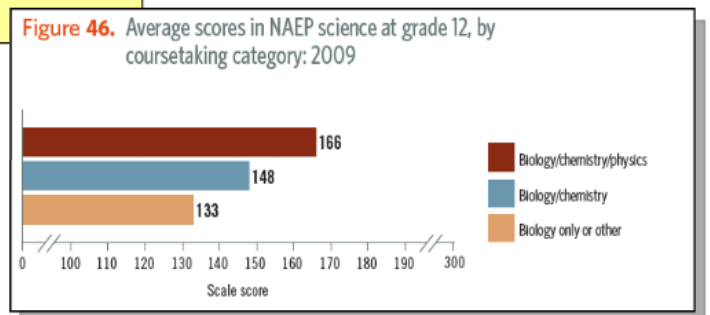
L. Model and explain how natural selection can change a population (10)
NAEP: L12.12; L12.7; L12.13
NGSS: HS-LS4-2; HS-LS4-3; HSLS4-4; HS-LS4-5; HS-LS3-3

M. Describe the major factors that influence speciation (10)
NAEP: L12.7; L12.13
NGSS: HS-LS4-1

N. Explain the theory of evolution by natural selection (10)
NAEP: L12.13; L12.11; L12.7
NGSS: HS-LS4-1; HS-LS4-4

J. Describe how communities progress through a series of changes (succession) (10)
NAEP: L12.7
NGSS: HS-LS2-6

*NGS: HS-LS2-7; HS-LS4-6 not categorized



2009 Nation's Report Card.

http://www.nextgenscience.org/hsls2-ecosystems-interactions-energy-dynamics
http://www.nextgenscience.org/hsls3-heredity-inheritance-variation-traits
http://www.nextgenscience.org/hsls4-biological-evolution-unity-diversity

*Footnote: Green boxes indicate OPI standards, Pink boxes indicate benchmarks and Blue boxes indicate Essential Learning Expectations (ELEs).

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Montana's Content Standards 3.5 and NAEP Practices

Content Standard 3—Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

5. Generate and apply biological classification schemes to infer and discuss the degree of divergence between ecosystems

- A. List and explain the characteristics of the three domains (10)
- B. Compare and contrast the key
- C. Explain how similarities and differences in the key characteristics of each kingdom indicate the degree of divergence between them (10)
- D. Explain the classification of living organisms from the domain to species level(10)
- E. Explain the importance of binomial nomenclature (10)
- F. Generate and use a dichotomous key (10)
- G. Differentiate between vascular and nonvascular plants
- H. Explain the difference between angiosperms and gymnosperms
- I. Compare and contrast major animal phyla
- J. Compare and contrast body systems between major animal phyla

Grade 12 NAEP Practices

Identifying Science Principles

1. Describes, measure, or classify observations.
2. State or recognize correct science principles.
3. Demonstrate relationships among closely related science principles.
4. Demonstrate relationships among different representations of principles.

Using Science Principles

1. Explain observation of phenomena.
2. Predict observations of phenomena.
3. Suggest examples of observations that illustrate a science principle.
4. Propose, analyze, and/or evaluate alternative explanations or predictions.

Hands-On Task—Maintaining Water Systems

Step 1: Predict
64% of students explained their preliminary recommendations with valid support based on the materials in their kits.

Step 2: Observe
75% of students could perform a straightforward investigation to test the water samples and accurately tabulate data.

Step 3: Explain
11% of students were able to provide a valid final recommendation by supporting their conclusions with details from the data.

Step 4 and 5: Extend
14% were able to correctly evaluate water treatment steps and select those that would be needed to remove pollutants that exceed national drinking water standards.
28% of students were able to describe scientific processes used to remove water pollutants.

Grade 12 Hands-On Tasks: Plant Pigments and Maintaining Water Systems.

Explore the Tasks

Page 7

The following question ref

A scientist studied the grow
into a flask of nutrient-rich
the number of living cells i

The graph below shows the

Number of Living Cells

1. The scientist wanted to
second flask of nutrient-
the growth of the bacter

The data showed that m
concluded that some of

Explain why some of th

Complete
Student response
of the bacteria re
a genetic mutatio
vided passing the
generation.

Partial
Student response
bacteria resistant
netic mutation.

Student response
bacteria divided
to the next gener

Unsatisfactory/In
Student response

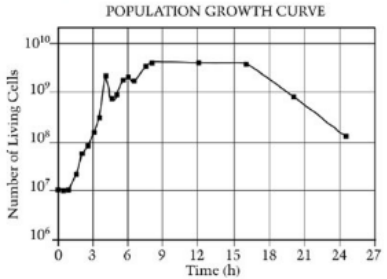
NOTE: Regular type
question. Italic type
tion. The position of
sents the scale score
65 percent probabil
constructed-response
ability of correctly a
choice question. SOU
tion, Institute of Educ
for Education Statisti
cational Progress (N

Use released NAEP Questions, available in the NAEP Questions Tool

The following question refer to the growth of bacteria.

A scientist studied the growth rate of a species of bacterium. The scientist introduced some of the bacteria into a flask of nutrient-rich solution and monitored the growth of the bacterial population by measuring the number of living cells in the solution.

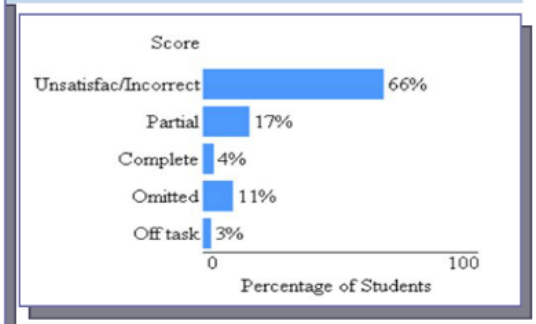
The graph below shows the growth of the bacterial population over time in hours (h).



1. The scientist wanted to determine the effect of an antibiotic on the growth of the bacterium. To a second flask of nutrient-rich solution with the bacterial cells, he added the antibiotic, and monitored the growth of the bacterial population.

   The data showed that most of the bacteria in the solution died, but some survived. The scientist concluded that some of the bacteria were resistant to the antibiotic.

   Explain why some of the bacteria were resistant to the antibiotic, based on the theory of evolution.



NOTE: These results are for public and nonpublic school students. Percentages may not add to 100 due to rounding. Off task applies to responses that do not address the question presented, are illegible, or cannot otherwise be scored.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2009 Science Assessment.

Complete
Student response correctly explains that some of the bacteria resistant to the antibiotic had a genetic mutation. The resistant bacteria divided passing the genetic mutation to the next generation.

Partial
Student response indicates that some of the bacteria resistant to the antibiotic had a genetic mutation.

OR

Student response indicates that the resistant bacteria divided, passing the genetic mutation to the next generation.

Unsatisfactory/Incorrect
Student response is inadequate or incorrect.

In the process of evolution, some members of a species may develop mutations that variate from the rest of the group. In some cases this mutation makes these members more able, or "fitter," to survive. Thus, survival of the fittest determines who lives and who dies.

NOTE: Regular type denotes a constructed-response question. Italic type denotes a multiple-choice question. The position of a question on the scale represents the scale score attained by students who had a 65 percent probability of successfully answering a constructed-response question, or a 74 percent probability of correctly answering a four-option multiple-choice question. SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2009 Science Assessment

GRADE 12 NAEP SCIENCE ITEM MAP

	Scale score	Content area	Question description
	300		
Advanced	292	Life science	Explain the cellular response to an external stimulus
	280	Physical science	*Identify nuclear force*
	269	Life science	Critique a conclusion about photosynthesis based on observations (**shown on pages 56 and 57**)
	244	Physical science	*Recognize a nuclear fission reaction*
	232	Earth and space sciences	*Compare methods for determining the age of the Earth*
	222		
Proficient	221	Physical science	*Explain a physical property in molecular terms*
	215	Physical science	Provide evidence of nuclear structure
	212	Earth and space sciences	*Identify a characteristic that distinguishes stars from planets*
	204	Life science	*Order levels of organization in living systems*
	198	Physical science	*Relate motion to conversion of kinetic energy to potential energy* (**shown on page 55**)
	194	Physical science	*Predict motion when unbalanced forces are applied*
	188	Earth and space sciences	Explain an alternative hypothesis about the effect of emissions released into the atmosphere
	186	Life science	Evaluate two methods to help control an invasive species
	184	Life science	*Draw a conclusion based on gases released during photosynthesis and respiration*
	180	Physical science	*Draw a conclusion based on observed physical properties*
	179		
Basic	178	Life science	*Predict the genetic makeup of individuals*
	177	Physical science	*Recognize atomic particles in an ion*
	176	Earth and space sciences	Predict differences in climate based on topography
	174	Earth and space sciences	*Draw a conclusion about the age of a sediment layer based on data*
	168	Physical science	*Solve a design problem related to the electric force between objects*
	167	Life science	*Recognize a useful product of photosynthesis*
	159	Life science	Predict the effect of a major disruption to a trophic level of an ecosystem
	155	Earth and space sciences	*Indicate a geologic event that explains a rock formation* (**shown on page 58**)
	150	Physical science	Improve the accuracy of an investigation about conservation of energy
	148	Physical science	*Relate an observation of a gas to molecular motion*
	143	Life science	*Determine relationships between species based on an evolutionary tree*
	142		
	135	Earth and space sciences	Design and evaluate a trade-off of a method to obtain drinking water
	128	Life science	*Draw a conclusion about population growth based on data*
	120	Physical science	Relate differences in chemical properties to differences in chemical bonds
	106	Physical science	*Interpret a motion graph*
	96	Life science	*Identify evidence to determine heredity*
	74	Life science	*Determine degree of reliableness based on trails*
	0		

2009 Nation's Report Card.

The following question refer to the following experiment.

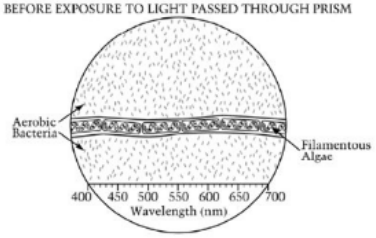
An experiment was conducted to determine which wavelengths of visible light are most effective for photosynthesis. The units shown here are in nanometers (nm).

Two organisms were used: filamentous algae, which are capable of photosynthesis, and some aerobic bacteria, which are not capable of photosynthesis.

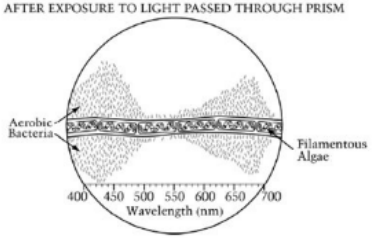
Both organisms were suspended in a water droplet and placed on a microscope slide. The slide was exposed to light that was passed through a crystal prism. (The prism was used to separate visible light into its wavelengths.)

The diagram below illustrates what was seen on the microscope slide before and one hour after exposure to light that was passed through the prism.

BEFORE EXPOSURE TO LIGHT PASSED THROUGH PRISM



AFTER EXPOSURE TO LIGHT PASSED THROUGH PRISM



Complete
Student response selects (A) Yes and provides a correct explanation that consists of three parts:
- explains that green light is not used or least effective for photosynthesis
- refers to the data that very few bacteria are clustered between 500-550 nm or the green region
- indicates that green light could be reflected or not absorbed

Essential
Student response selects (A) Yes and addresses two parts of a correct explanation.

OR

Student response does not select (A) but addresses three parts of a correct explanation.

Partial
Student response indicates (A) Yes and addresses one part of a complete response correctly.

OR

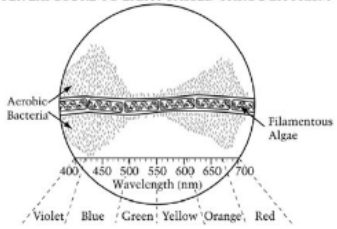
Student response selects (B) No or makes no selection, but addresses one or two parts of a complete response correctly.

Unsatisfactory/Incorrect
Student response is inadequate or incorrect.

Critique a conclusion about photosynthesis based on observations

3. The diagram below illustrates what was seen on the microscope slide one hour after exposure to light that was passed through a prism. The colors associated with the wavelengths of light are also indicated.

AFTER EXPOSURE TO LIGHT PASSED THROUGH PRISM



Based on the results of the experiment, a student concludes that the scientist used algae that was green.
Do you agree with the student's conclusion?

A. Yes
B. No

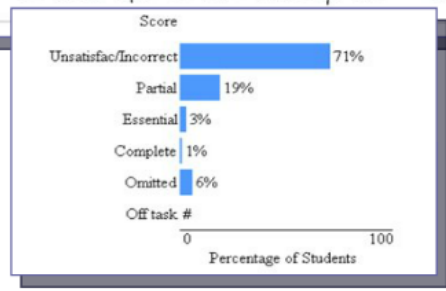
Refer to the results from the experiment to support your answer.

Do you agree with the student's conclusion?

● Yes
○ No

Refer to the results from the experiment to support your answer.

If the algae was green, then it would have reflected the green light rather than absorbing it for photosynthesis. It is obvious that the algae didn't conduct any photosynthesis at the green light given the small amount of bacteria located in that spectrum. Therefore the algae must have been green.



Rounds to zero.

NOTE: These results are for public and nonpublic school students. Percentages may not add to 100 due to rounding. Off task applies to responses that do not address the question presented, are illegible, or cannot otherwise be scored.

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2009 Science Assessment.

Percentage of answers rated as "Complete," "Essential," and "Partial" for twelfth-grade students at each achievement level: 2009

Scoring level	Overall	Below *Basic*	At *Basic*	At *Proficient*	At *Advanced*
Complete	1	#	#	3	‡
Essential	3	#	1	13	‡
Partial	19	5	21	42	‡

2009 Nation's Report Card.

http://nces.ed.gov/nationsreportcard/tel/

TECHNOLOGY

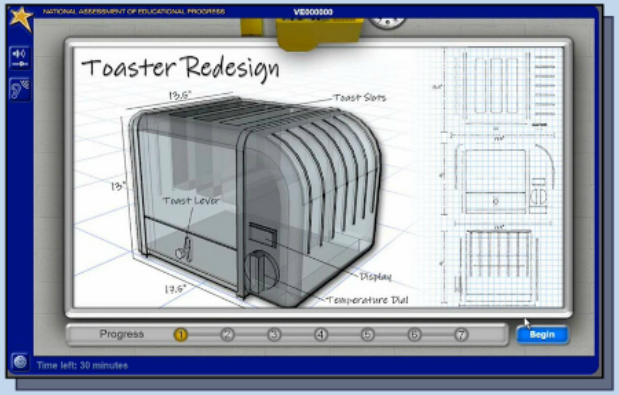
TEL IS CROSS-CURRICULAR.

Total of **18,000** students will participate in NAEP's 2014 TEL assessment.

⇒ TEL is a computer based assessment which will measure students' capacity to use, understand, and evaluate technology, as well as to understand technological principles and strategies.

⇒ Students will spend about 120 minutes completing the assessment.

⇒ For more information on the cognitive demands and expectations for students, please visit the NAEP TEL framework at: http://www.nagb.gov/publications/frameworks/technology/2014-technology-framework/toc.html



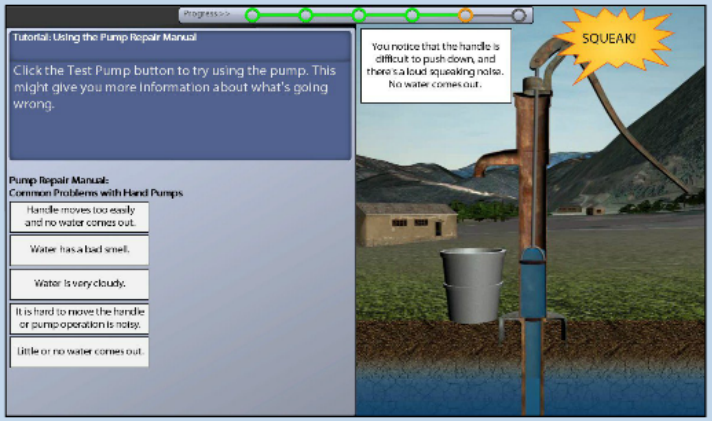
What is TEL?

NAEP
NATIONAL ASSESSMENT OF EDUCATIONAL PROGRESS

What does a TEL item look like?

Can I try a TEL item?

Interactive Framework



http://nationsreportcard.gov/science_2009/ict_tasks.aspx

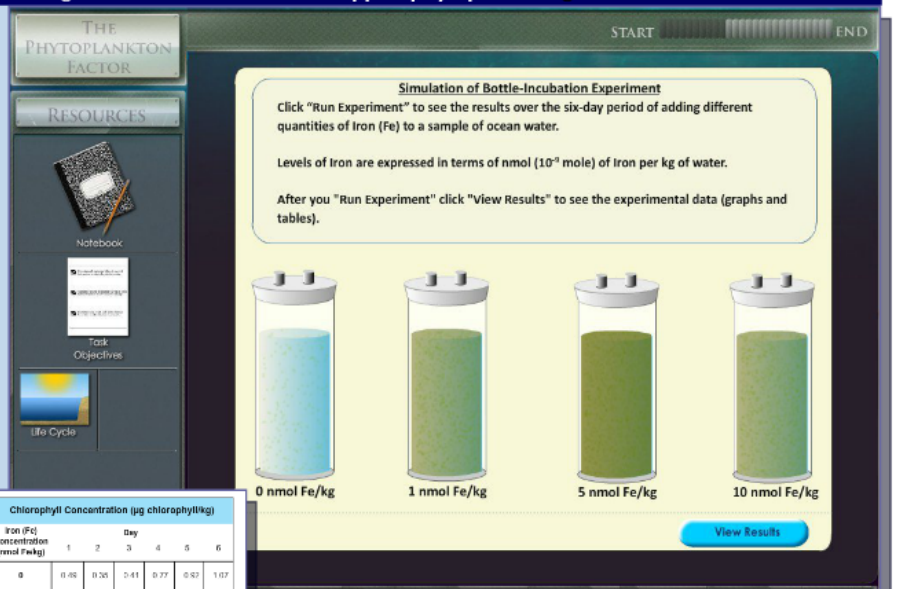
Grade 12 Phytoplankton Factor

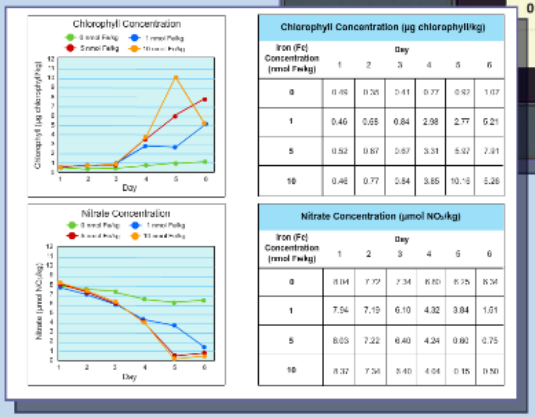
Investigate ocean conditions that support phytoplankton growth

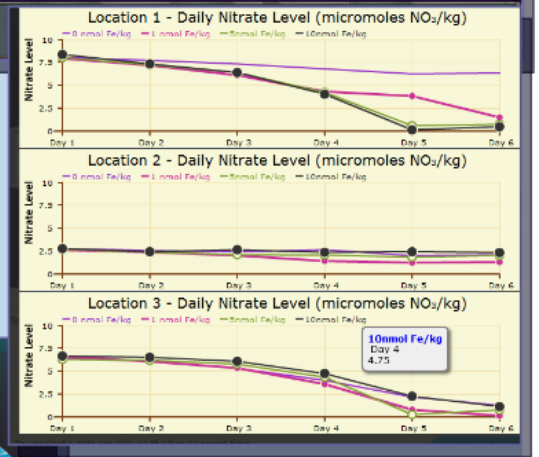
Total of 15 questions for the 40 minute extended task.

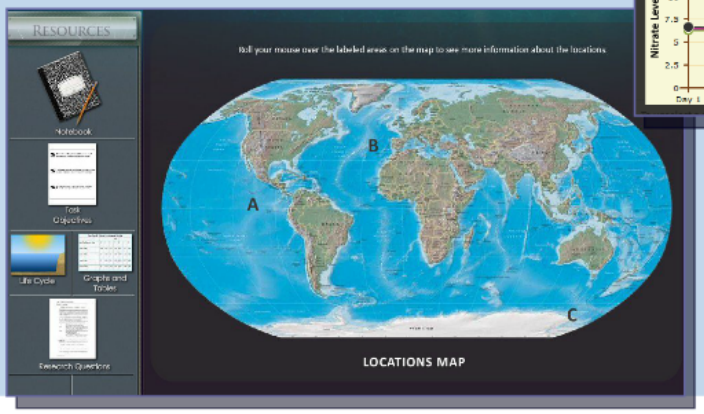
⇒ Supplies student with their answer and the correct answer at the conclusion of the test.

⇒ Answers for grade 12 national students is shown in a table.





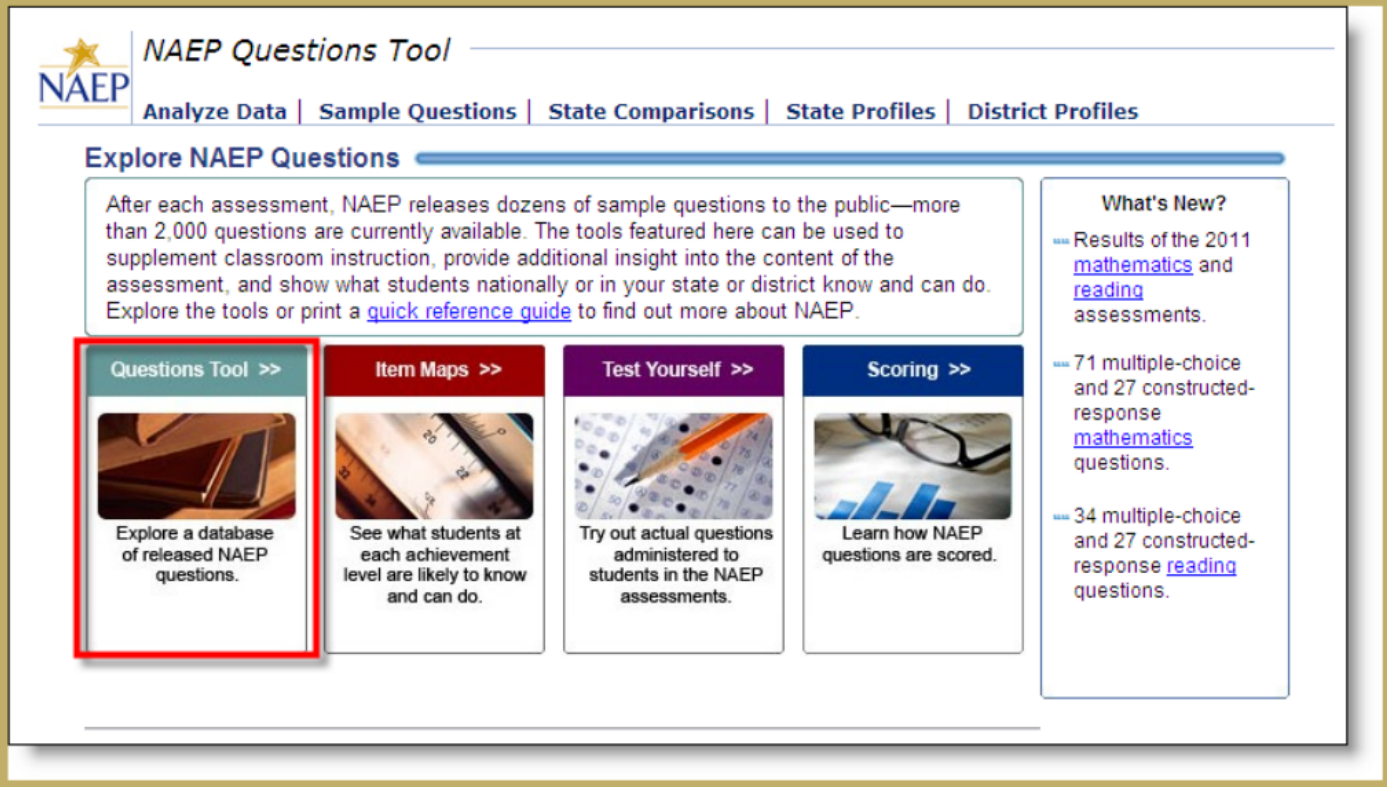




Grade 12 Interactive Computer Tasks (ICTs): Starlight, Energy Transfer and The Phytoplankton Factor.

Explore the Tasks

Using the NAEP Questions Tool to Locate Additional Test Items



Why Use Released Test Items for Local Test Development?

- Saves time – already tied to standards
- Uses real test questions as examples
- Provides students with realistic test environment; lowers test anxiety
- Provides local test design with valid examples
- Extends assessment literacy
- Provides perspective on testing process for teachers and administrators as a professional development opportunity
- Is easily adaptable to formative assessment

Exploring NAEP Questions Tool (NQT)

http://nationsreportcard.gov/educators.asp

Left-hand navigation bar

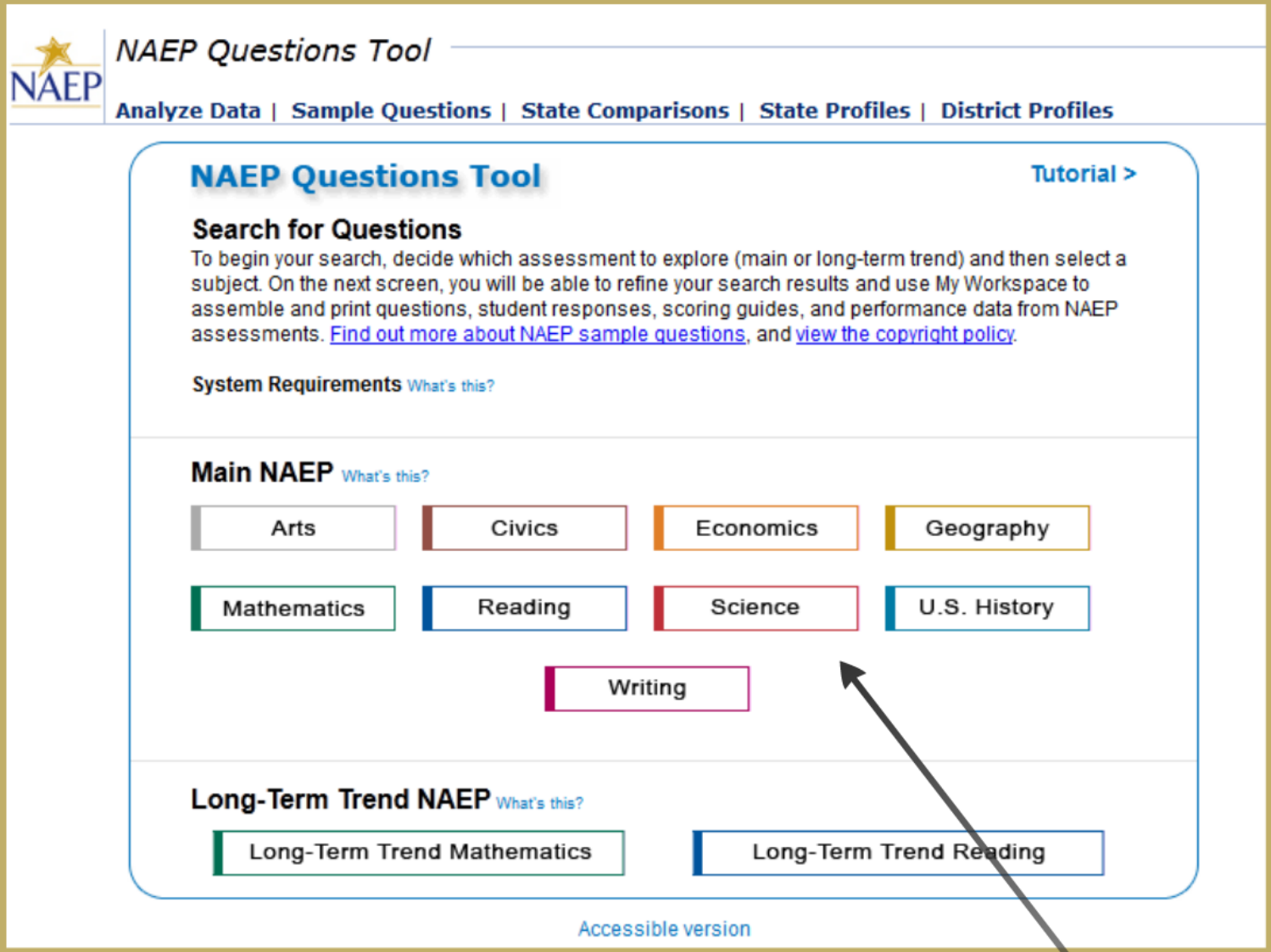
Search utility

Links to information by subjects assessed

Information for target audiences

Create your own test via NAEP Questions Tools

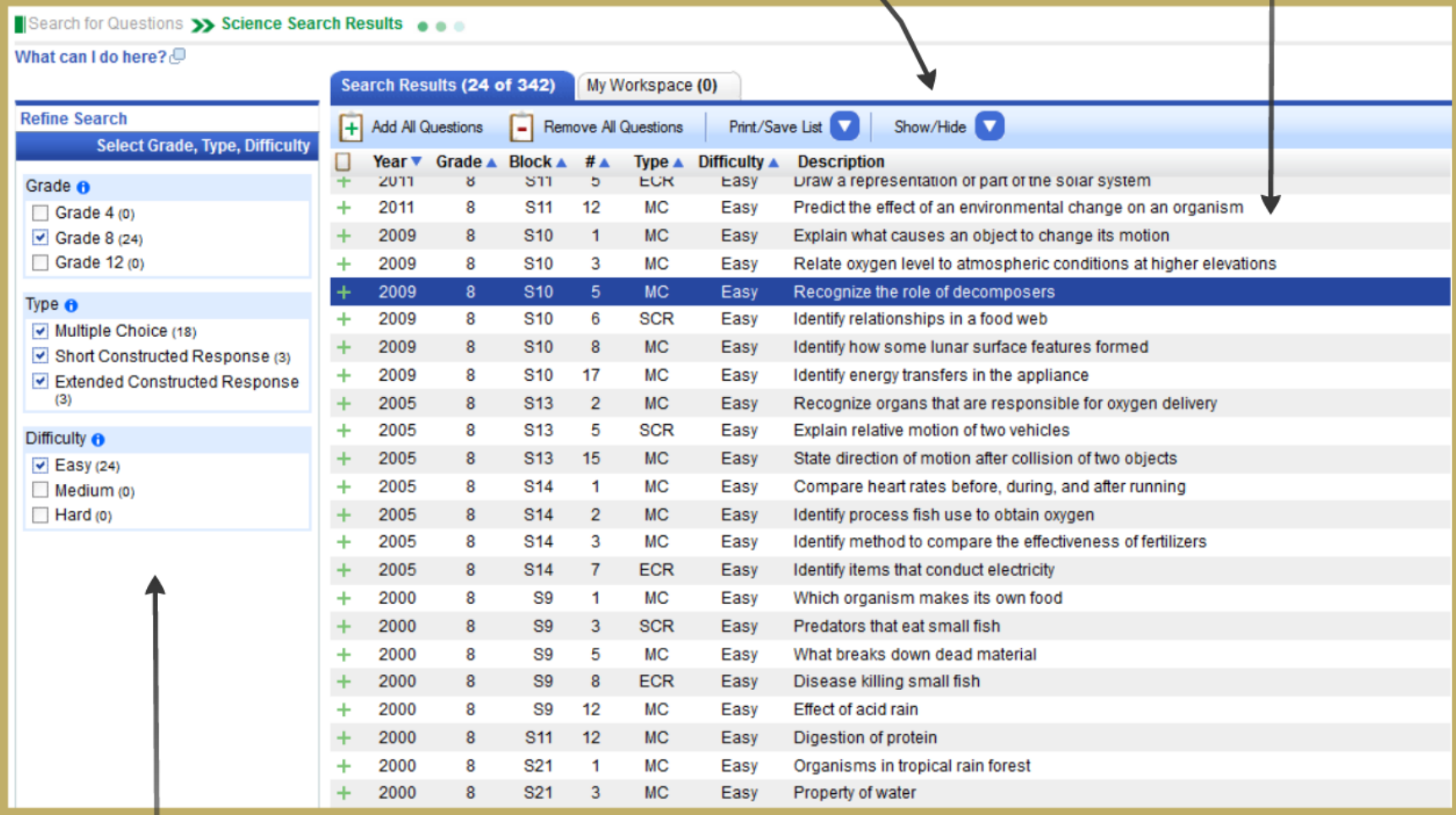
The NAEP Questions Tool is probably the most popular with both teachers and students.



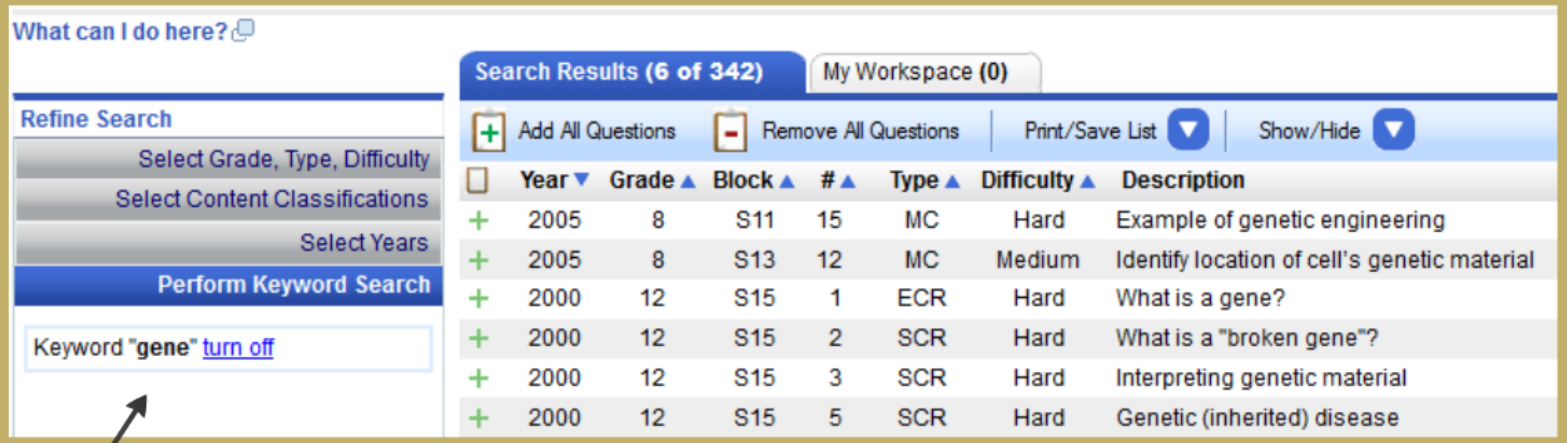
Let's explore some NAEP science questions

Show/Hide: include content subtopics, etc.

Questions: year, grade, type, difficulty and description.

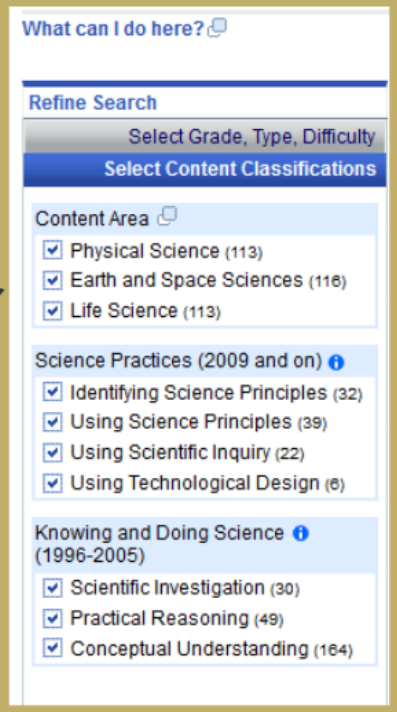


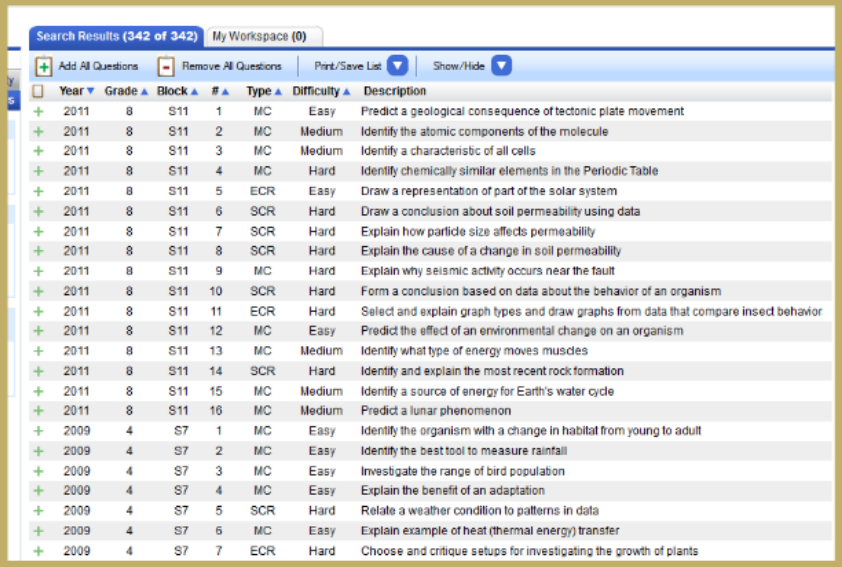
Select and refine your available questions



Deselect refined searches

Examine content areas for application into classroom units





Explore question details

Refine Search

Select Grade, Type, Difficulty

Select Content Classifications

Select Years

Perform Keyword Search

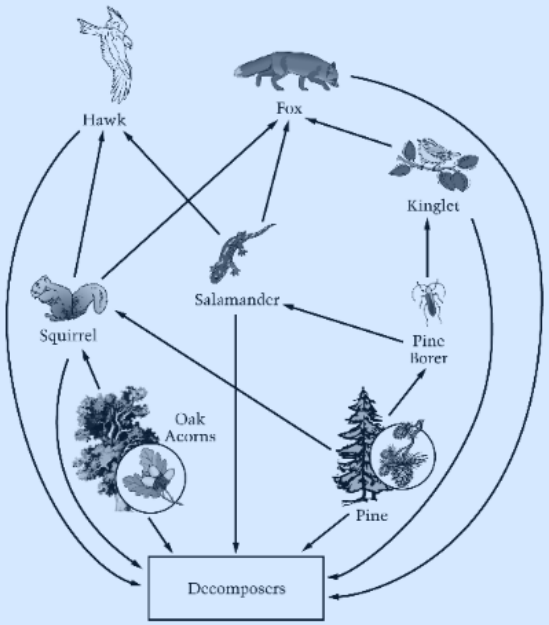
Go

Search question descriptions for subject-specific keywords, e.g., calculator.

Search questions for specific keywords (e.g., food web)

Questions 5-7 refer to the diagram below, showing a food web. The arrows show the direction of energy flow. Each arrow points from the or
to answer the questions that follow.

FOOD WEB



5. Which statement best explains why decomposers are an important part of this food web?

Question Information

- **Description:** Recognize the role of decomposers
- **Grade:** 8
- **Year:** 2009
- **Block & Number:** Block S10 Question #5
- **Type of Question:** Multiple Choice
- **Difficulty:** Easy (64.61% Correct)
- **Content Classification:**
  - **Content Area:** Life Science
  - **Science Practices (2009 and on):** Identifying Science Principles

Save your selections

+ Add to My Workspace (0)

<< Question 6 of 24 >>

Print

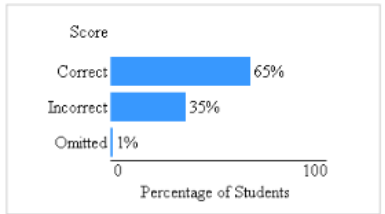
View question results

Question | Key/Scoring Guide | National Data | Jurisdiction Data

Totals

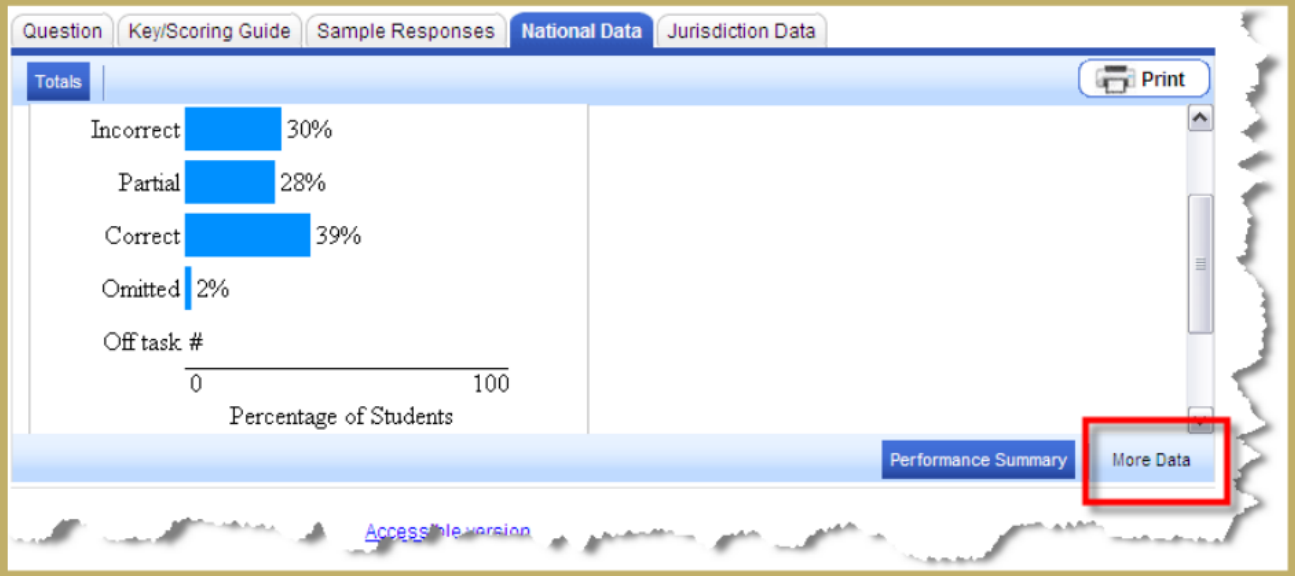
NAEP national performance results in Science at grade 8: 2009

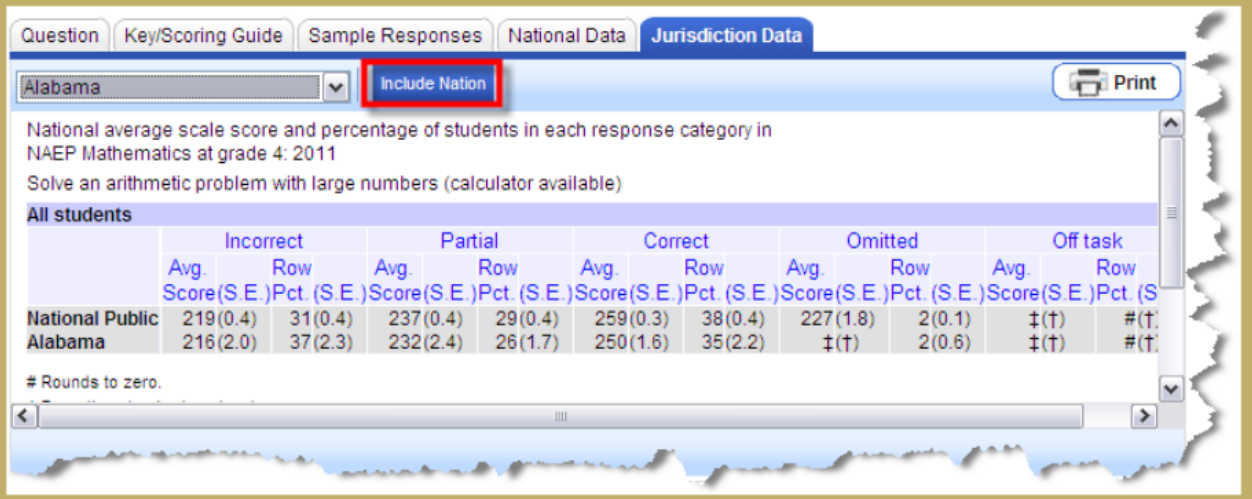
Recognize the role of decomposers



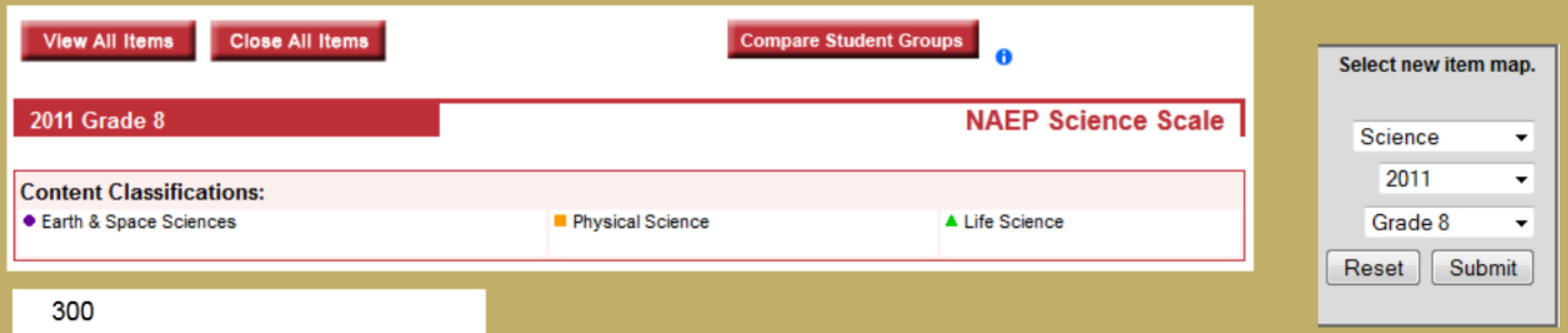
NOTE: These results are for public and nonpublic school students. Percentages may not add to 100 due to rounding.

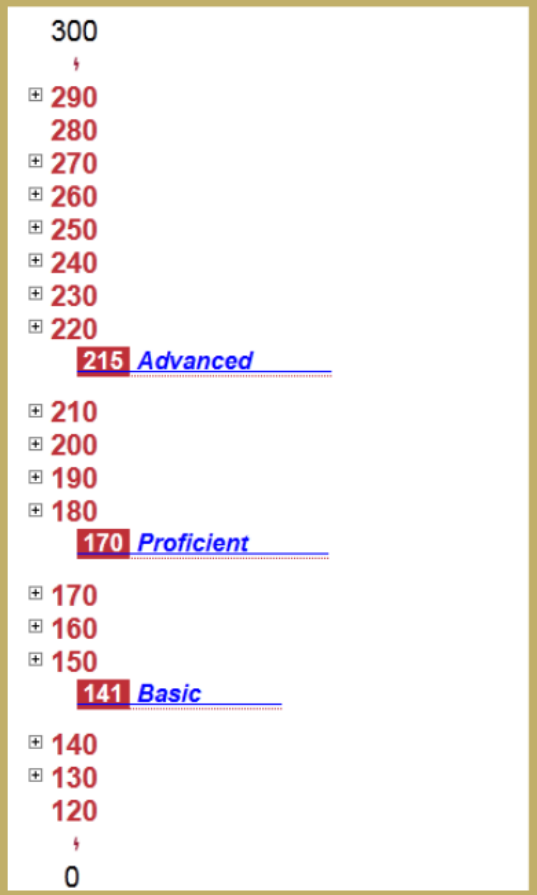
The NAEP Questions Tool

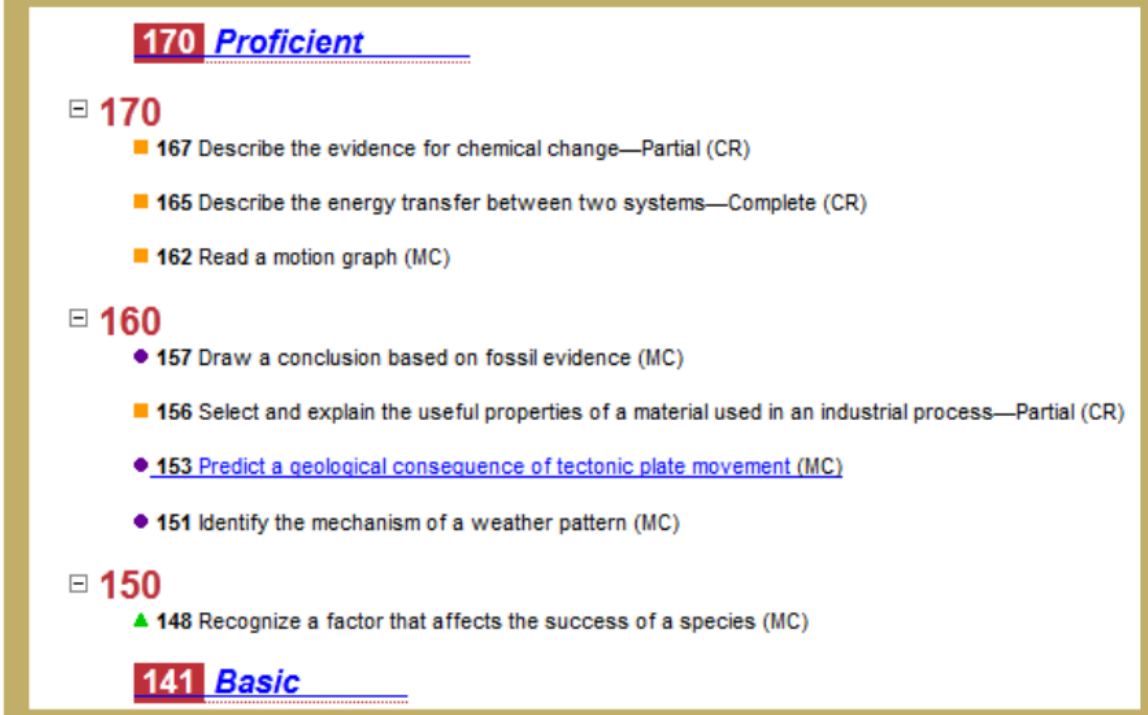




Item Maps







http://nces.ed.gov/nationsreportcard/itemmaps/index.asp

1. Interactive Computer Tasks

GRADE 4
Cracking Concrete
Predict the effect of the freeze/thaw cycle on a concrete sidewalk.
Duration: 20 minutes
Take this task >
Scoring information >

GRADE 4
Here Comes the Sun
Predict path of the sun and number of daylight hours to determine best planting location.
Duration: 20 minutes
Take this task >
Scoring information >

GRADE 4
Mystery Plants
Determine optimum amount of light and nutrients for plant growth.
Duration: 40 minutes
Take this task >
Scoring information >

GRADE 8
Bottling Honey
Investigate flow rates of four liquids to determine best temperature for bottling honey.
Duration: 20 minutes
Take this task >
Scoring information >

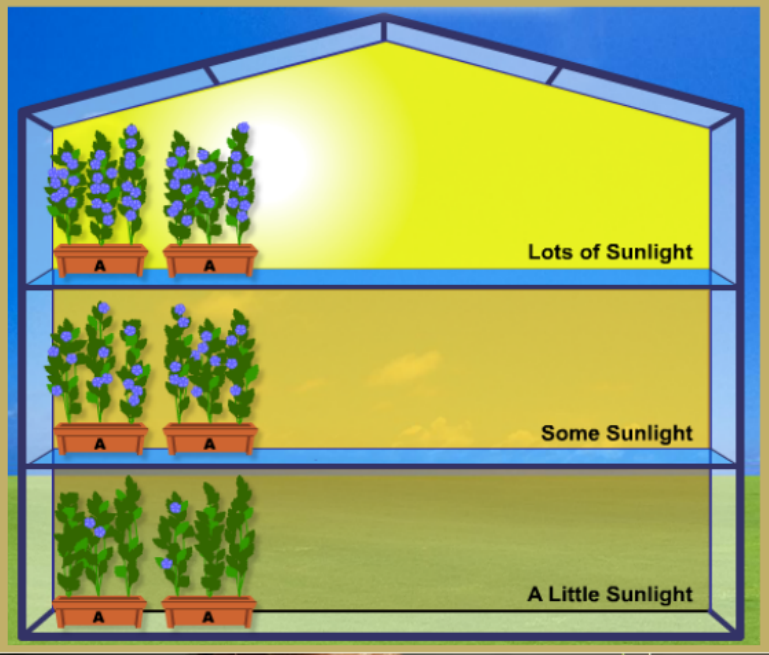
GRADE 8
Playground Soil
Investigate attributes of two soil samples to determine the best site for building a playground.
Duration: 20 minutes
Take this task >
Scoring information >

GRADE 8
Planning a Park
Evaluate the impact of a planned recreation park on specific organisms.
Duration: 40 minutes
Take this task >
Scoring information >

GRADE 12
Energy Transfer
Investigate energy transfer between substances to determine the best metal for a cooking pot.
Duration: 20 minutes
Take this task >
Scoring information >

GRADE 12
Starlight
Investigate relationships between the luminosity and temperature of different stars.
Duration: 20 minutes
Take this task >
Scoring information >

GRADE 12
Phytoplankton Factor
Investigate ocean conditions that support phytoplankton growth.
Duration: 40 minutes
Take this task >
Scoring information >



http://nationsreportcard.gov/science_2009/ict_tasks.asp

2. Hands-On Tasks (HOTs)
aka Performance Based Activity (Investigations)

- 40 minute activities
- Grades 4, 8 & 12
- Engaging
- Challenging
- Demonstrate scientific knowledge and lab skills
- Define how well students can apply their understanding of science in real-life contexts

Key Discovery 1

Students were successful on parts of investigations that involved limited sets of data and making straightforward observations of that data.

Key Discovery 2

Students were challenged by parts of investigations that contained more variables to manipulate or involved strategic decision making to collect appropriate data.

Key Discovery 3

The percentage of students who could select correct conclusions from an investigation was higher than for those students who could select correct conclusions and also explain their results.

Nation's Report Card

Item Source: Quellmalz et al., 2004 (Specifications, p. 121)

Lynx/Hare Task

This is an interactive computer task in which students are expected to conduct a scientific investigation regarding the question of whether or not lynx should be introduced into a national park in order to reduce the abiding overpopulation of hares. Students are directed to complete six modules, which make use of different computer programs in order to determine the best solution for the proposed question:

Module 1 asks the student to access, organize, analyze, and interpret data that they are given about the populations of hares over the past four years, using Word processor, Spreadsheet, or Presentation software.

Module 2 asks the student to determine a better way to analyze and display some disorganized data that show how many lynx and hares were present each year over the past 25 years.

Module 3 ...
Module 4 ...
Module 5 ...
Module 6 ...

Scores for this task are given for inquiry skills and technology use, along with the appropriate use of concepts within their explanations and recommendations.

For more information, see http://ipat.sri.com/tasks/pred_prey/subtasks/taskstud.html

Item Scoring Agenda

- Multiple Choice Scoring
- Short Constructed-Response Scoring
- Extended Constructed-Response Scoring
- Item Distribution
- Scoring Logistics
- Training Materials
- Item (Question)
- Scoring Guide & Rubric
- Anchor Sets
- Scoring Sheets
- Practice Sets

The Goal of Scoring

"Our goal is to make consistent and accurate judgments about what students know and can do based on their given responses, while maintaining the highest standards of measurement precision."

Eunice Greer, Senior Research Scientist National Center for Education Statistics

Multiple Choice Items

3. Why does Rosa return to the school yard?

(A.) She has forgotten her homework assignment.

(B.) She wants to play baseball with her friends.

(C.) She needs to get help for the ducks.

(D.) She wants to show her teacher a duck.

- Only one correct response
- Scanned and scored electronically
- Inexpensive to score

NAEP Scoring

- Three types of items are scored for NAEP:
  - Multiple Choice Scoring
  - Short Constructed-Response Scoring (2-3 score points)
  - Extended Constructed-Response Scoring (4 or more score points)

- Develops focused, explicit scoring guides matched to assessment frameworks

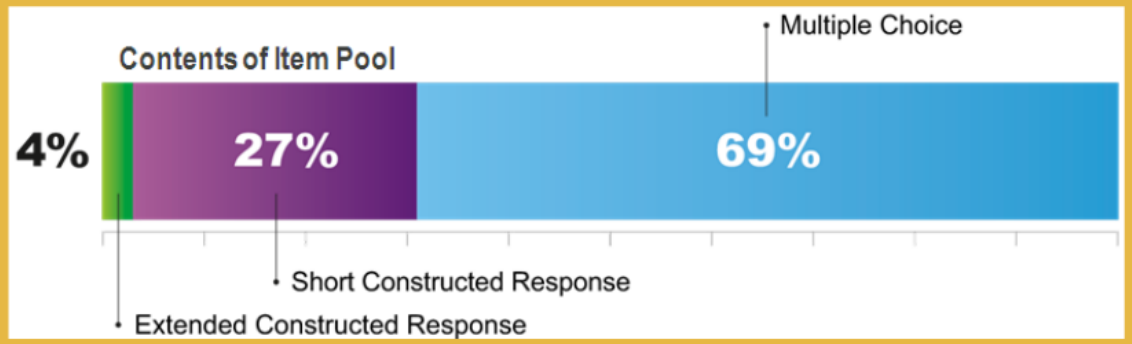
- Using qualified and experience scorers

- Monitors scoring consistency
- Assesses scorer decision-making
- Documents all scoring aspects of the assessment

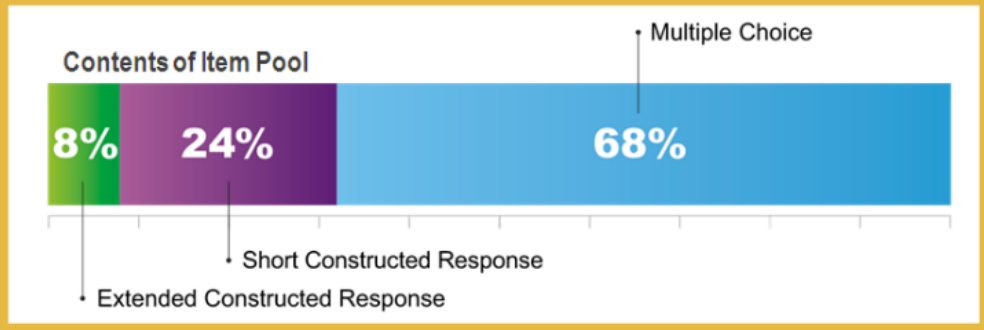
Processing and scoring totals, national main and state assessments, by year and subject area: 2000–2008

Year	Subject Area	Grade	Number of booklets scored	Number of constructed responses	Number of individual cognitive items	Number of team leaders	Number of scorers
2005	Mathematics	4,8,12	354,500	4,435,831	414	26	267
	Reading	4,8,12	340,200	3,773,691	226	36	363
	Science	4,8,12	349,100	4,424,511	539	39	393

Item Type Distribution: Mathematics



Item Type Distribution: Reading



Item Type Distribution: Science

Short Constructed-Response Items

$\square - 8 = 21$

What number should be put in the box to make the number sentence above true?

Answer: _____

2 Score Category
Correct
Incorrect

There are many different kinds of human-made satellites orbiting the Earth. List three things that these satellites are used for.

_____

_____

_____

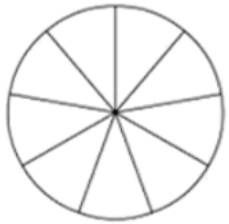
3 Score Category
Complete
Partial
Unacceptable or incorrect

Extended Constructed-Response Items

From the time she catches the fish until she lets it go, the speaker's feelings about the fish change. Tell how her feelings change and what causes them to change. Explain your answer by referring specifically to the poem.

4 Score Category
Complete
Essential
Partial
Incorrect

Luis wants to make a game spinner in which the chance of landing on blue will be twice the chance of landing on red. He is going to label each section either red (R) or blue (B). Show how he could label his spinner.

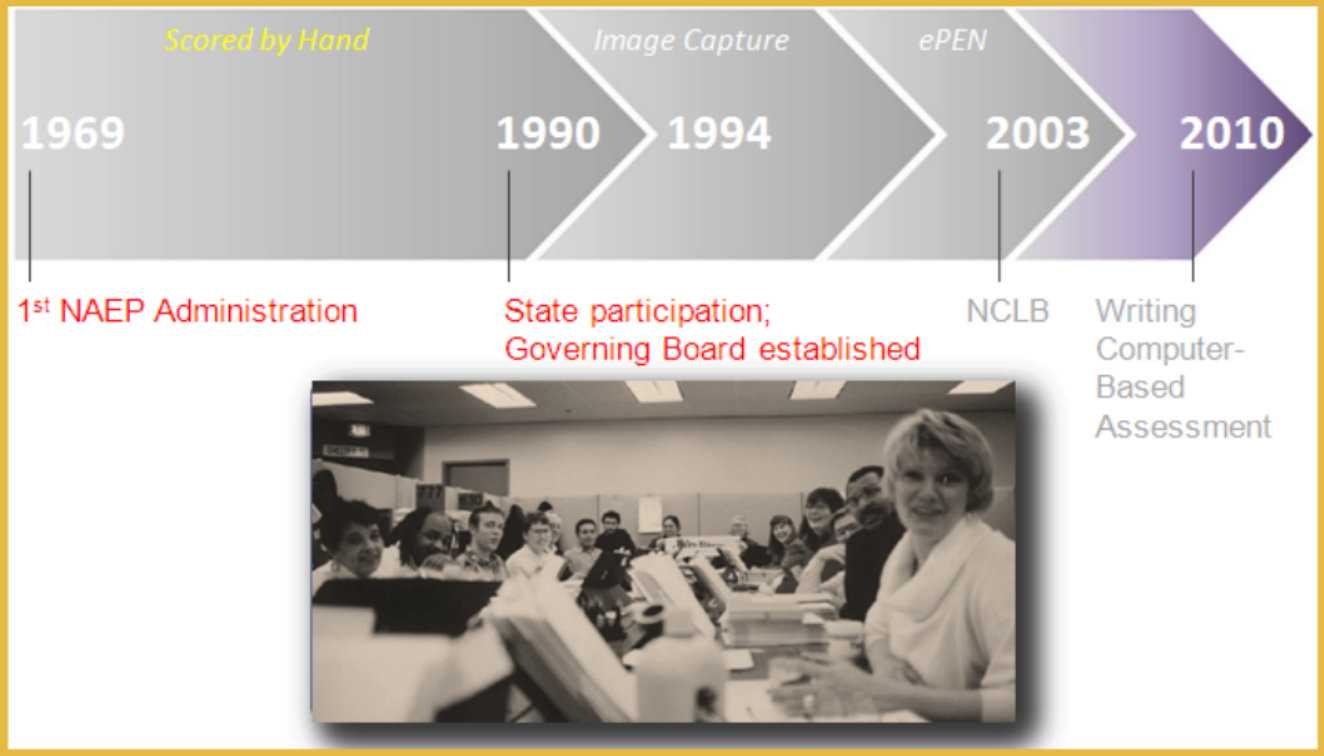


Number of blues: _____
Number of reds: _____

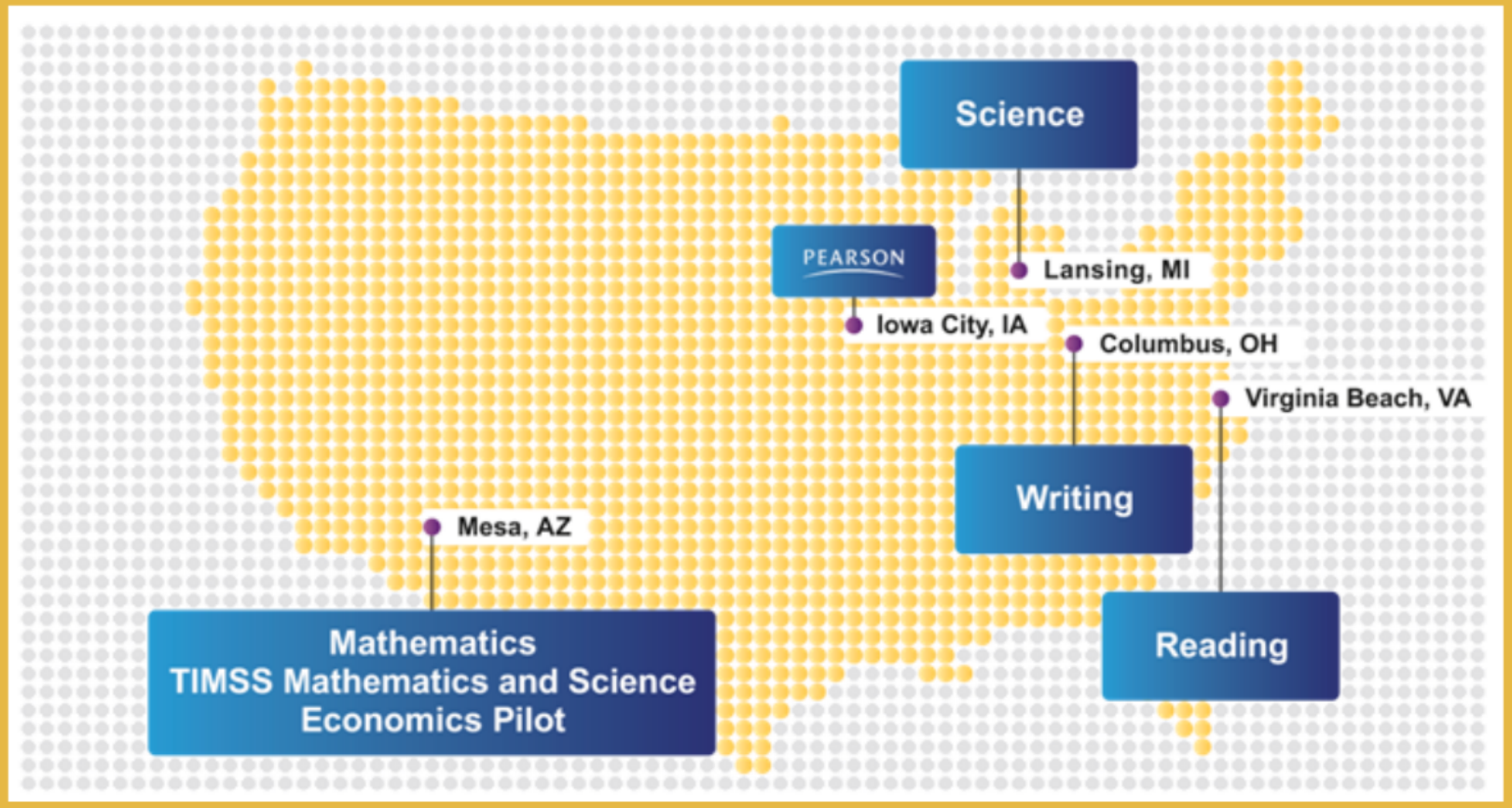
Explain how you found your answer.

5 Score Category
Extended
Satisfactory
Partial
Minimal
Incorrect

History of Scoring



Scoring Sites



Scorer Qualifications

- Minimum of baccalaureate degree from 4 yr university
- An advanced degree and scoring experience and/ or teaching experience (preferred)
- Some require placement tests

Constructed Response Scoring

Preliminary Activities to Scoring

- Create teams
- Overview of NAEP assessment
- Scoring guidelines
- Backreading
- Interrator agreement
- Calibration sets
- Scoring rate expectations
- Evaluations
- Scorer bias
- Grade-level considerations

Scoring Teams:

- 10-12 Scorers
- Scoring Trainers
- Scoring supervisors

Images from: Welcome to NAEP Video

Constructed Response Scoring

- Item-level training (one item at a time)
- All responses for that item are scored by the team before next item is introduced- accuracy
- Documentation of scoring decisions
- Refinements to scoring guides (not common during operational)
- Science Interrater Agreement 25 % of responses are second scored

Within-Year Interrater Agreement
Target standards:

- items scored on 2-point scales: 85 percent exact agreement,
- items scored on 3-point scales: 80 percent exact agreement,
- items scored on 4-point and 5-point scales: 75 percent exact agreement, and
- items scored on 6-point scales: 60 percent exact agreement.

Anchor sets-are used to illustrate the item-specific scoring guide. Anchor sets include papers that show three or four clear examples of each score category.

Practice sets-contain both clear examples of each score level as well as some borderline papers (responses on the border of two adjacent score levels). and

Qualifying sets-Scorers must qualify individually before they begin scoring any extended constructed-response items and for selected short constructed-response items depending on the level of complexity of the item and scoring guide.

Achieve a certain percentage of exact agreement with the scores :

- 90 percent exact agreement for 2-point items,
- 80 percent exact agreement for 3-point items,
- 70 percent exact agreement for 4-point items,
- 70 percent exact agreement for 5-point items,
- 70 percent exact agreement for 6-point items.

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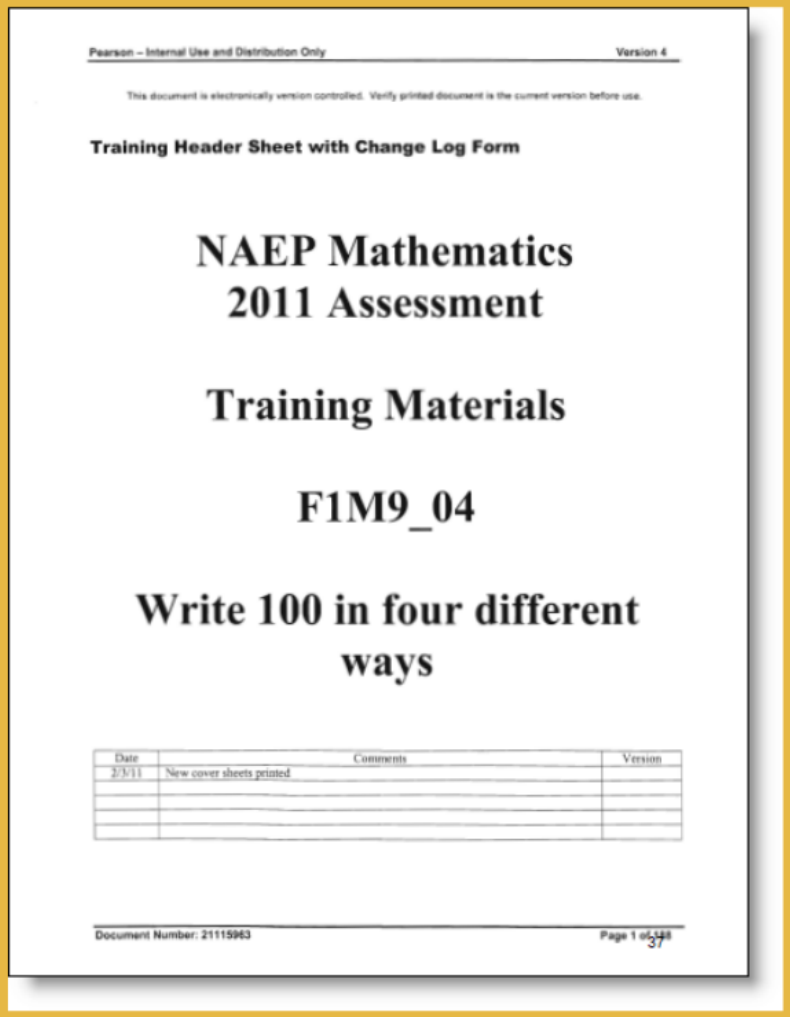
Training Materials – Cover Page



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Training Header Sheet with Change Log Form

NAEP Mathematics 2011 Assessment

Training Materials

F1M9_04

Write 100 in four different ways

Date	Comments	Version
2/3/11	New cover sheets printed	

Document Number: 21115963 Page 1 of 488

Training Materials - Question

Grade	Block Code	Sequence	Item Type
4	F1M9	4	Constructed-response (nonextended)

Content Area	Number Properties and Operations	
Topic	1) Number sense	
Objective	d) Write or rename whole numbers (e.g., 10: 5 + 5, 12 – 2, 2 x 5).	
Mathematical Complexity	Low	
Achievement Level	Basic	
Calculator Activity		
Tools	N/A	

Item:

VC1-F0717

Tanika wrote 100 in four different ways.

$85 + 15$ $70 + 30$

$141 - 41$ $200 \div 2$

Write 100 in four other ways. Do <u>not</u> use the numbers that Tanika used.

1. _____

2. _____

3. _____

4. _____

Training Materials – Scoring Guide & Rubric

Grade	Block Code	Sequence	Item Type
4	F1M9	4	Constructed-response (nonextended)

Scoring Guide

Sample Correct Response:

1. 10×10
2. $25 + 75$
3. $125 - 25$
4. $158 - 58$

Four acceptable ways to write 100 are given above.

Scoring Rubric:

	Code	Description
Correct	3	Response includes 4 different acceptable ways
Partial	2	Response includes 3 different acceptable ways and no more than 1 unacceptable way
Incorrect	1	Incorrect response, including only 1 or 2 acceptable ways

Notes:

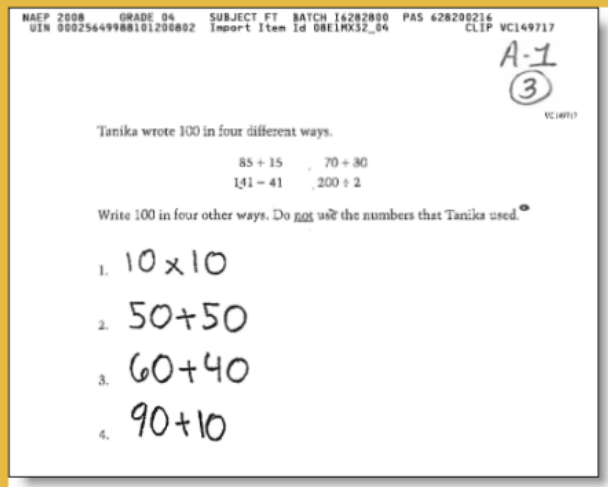
- Use of the following pairs of numbers is unacceptable: 85 and 15, 70 and 30, 141 and 41, or 200 and 2.
- Use of "individual" given numbers (e.g., "2" in 2×50) is acceptable.
- Acceptable responses can include any combination of operations.
- Use of more than two numbers is acceptable, for example $600 \div (3 \times 2)$

Training Materials – Anchor Set

NAEP Mathematics
F1M9_04
Write 100 in four different ways
Anchor Set

Paper	Ref #	Score	Notes
A-1	2	3	Response includes 4 different acceptable ways (*10×10, 50+50, 60+40, 90+10*).
A-2	132	3	Response includes 4 different acceptable ways (*50 ×2=100, 150-50=100, 75+25=100, 100÷1*=100).
A-3	104	3	Response includes 4 different acceptable ways (*50+50, 25+25+25+25, 75+25, 60+40*).
A-4	141	3	Response includes 4 different acceptable ways (*50+50,100×1, 151-51, 80+20*).
A-5	163	2	Response includes 3 acceptable ways and 1 unacceptable way. (*60+50=100*) is not correct.
A-6	133	2	Response includes 3 acceptable ways and 1 unacceptable way. (*70+30*) is given in the prompt.
A-7	120	2	Response includes 3 acceptable ways and 1 unacceptable way. (*30+70*) is a given number pair.
A-8	109	2	Response includes 3 acceptable ways and 1 unacceptable way. (*84+17*) is not correct.
A-9	144	1	Response includes more than 1 unacceptable way. Both (*50 +5=100* and *100 ÷0=100*) are incorrect.
A-10	153	1	Response includes more than 1 unacceptable way. All 4 answers are numbers that are given in the prompt.

Training Materials – Anchor Set


NAEP 2008 GRADE 04 SUBJECT FT BATCH I6202800 PAS 628200216
UIN 00025649988101200802 Import Item Id 08E1MX32_04 CLIP VC149717

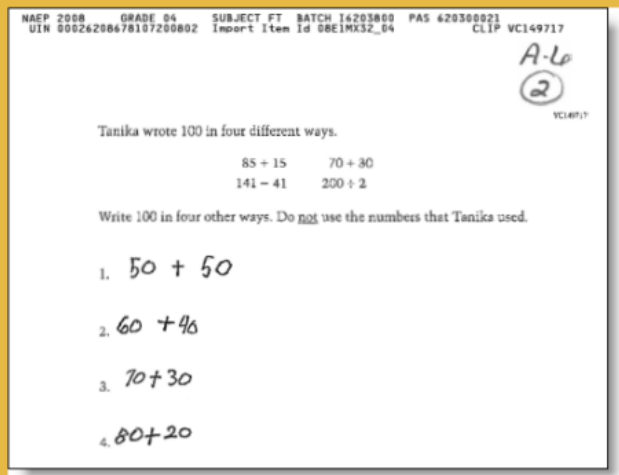
A-1
(3)

Tanika wrote 100 in four different ways.

85 + 15 70 + 30
141 − 41 200 ÷ 2

Write 100 in four other ways. Do not use the numbers that Tanika used.

1. 10 x 10
2. 50+50
3. 60+40
4. 90+10


NAEP 2008 GRADE 04 SUBJECT FT BATCH I6203800 PAS 620300021
UIN 00026208678107200802 Import Item Id 08E1MX32_04 CLIP VC149717

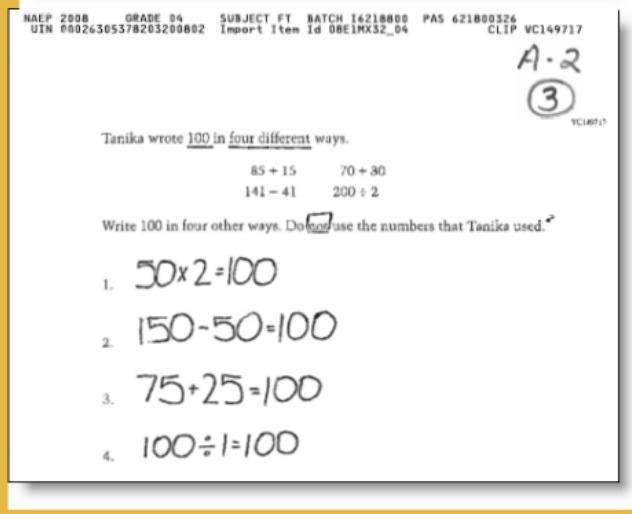
A-6
(2)

Tanika wrote 100 in four different ways.

85 + 15 70 + 30
141 − 41 200 ÷ 2

Write 100 in four other ways. Do not use the numbers that Tanika used.

1. 50 + 50
2. 60 +40
3. 70+30
4. 80+20


NAEP 2008 GRADE 04 SUBJECT FT BATCH I6218800 PAS 621800326
UIN 00026305378203200802 Import Item Id 08E1MX32_04 CLIP VC149717

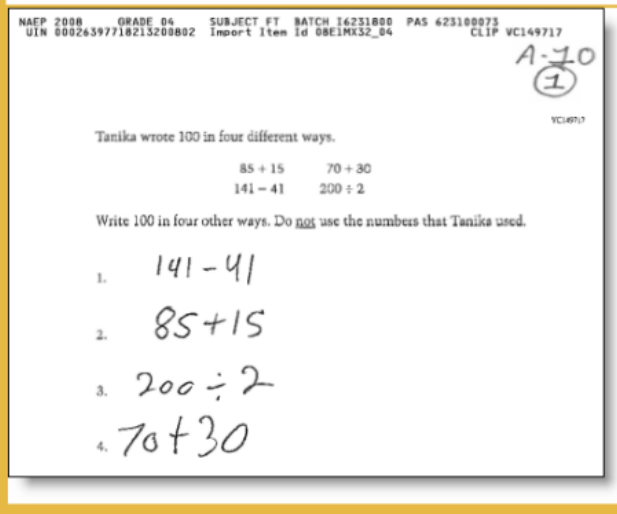
A-2
(3)

Tanika wrote 100 in four different ways.

85 + 15 70 + 30
141 − 41 200 ÷ 2

Write 100 in four other ways. Do not use the numbers that Tanika used.

1. 50x2=100
2. 150-50=100
3. 75+25=100
4. 100÷1=100


NAEP 2008 GRADE 04 SUBJECT FT BATCH I6231800 PAS 623100073
UIN 00026397718213200802 Import Item Id 08E1MX32_04 CLIP VC149717

A-10
(1)

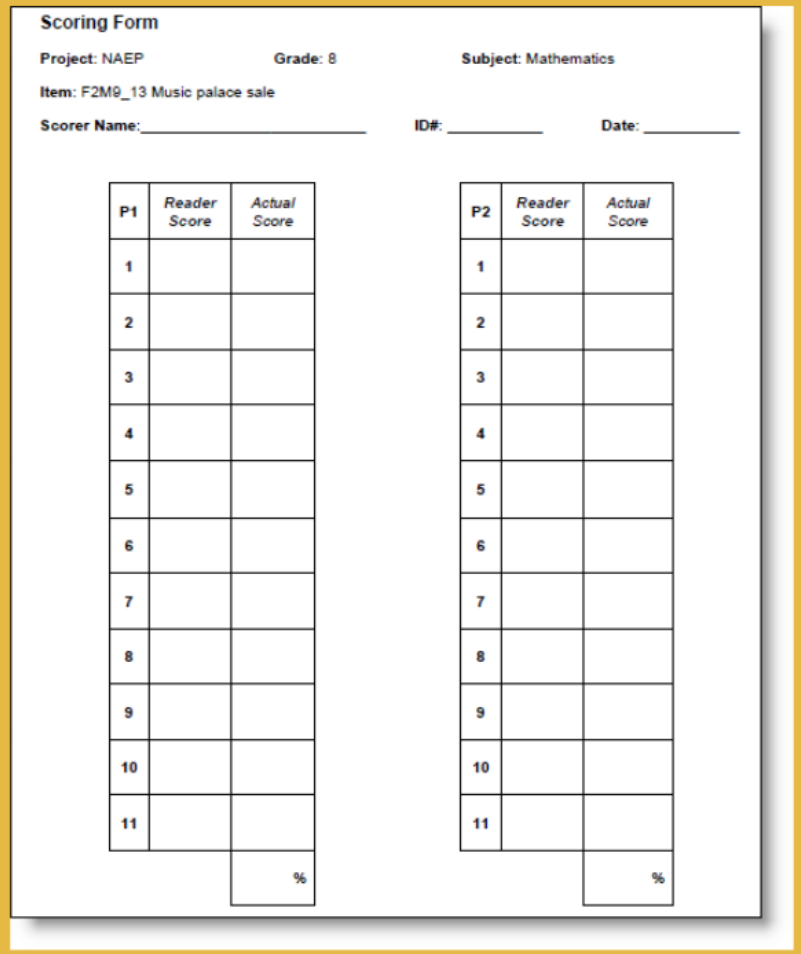
Tanika wrote 100 in four different ways.

85 + 15 70 + 30
141 − 41 200 ÷ 2

Write 100 in four other ways. Do not use the numbers that Tanika used.

1. 141-41
2. 85+15
3. 200÷2
4. 70+30

Training Materials – Scoring Form



Scoring Form

Project: NAEP **Grade:** 8 **Subject:** Mathematics

Item: F2M9_13 Music palace sale

Scorer Name:_____ **ID#:** _____ **Date:** _____

P1	*Reader Score*	*Actual Score*
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
		%

P2	*Reader Score*	*Actual Score*
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
		%

Potential scorers use this form to record practice scores.

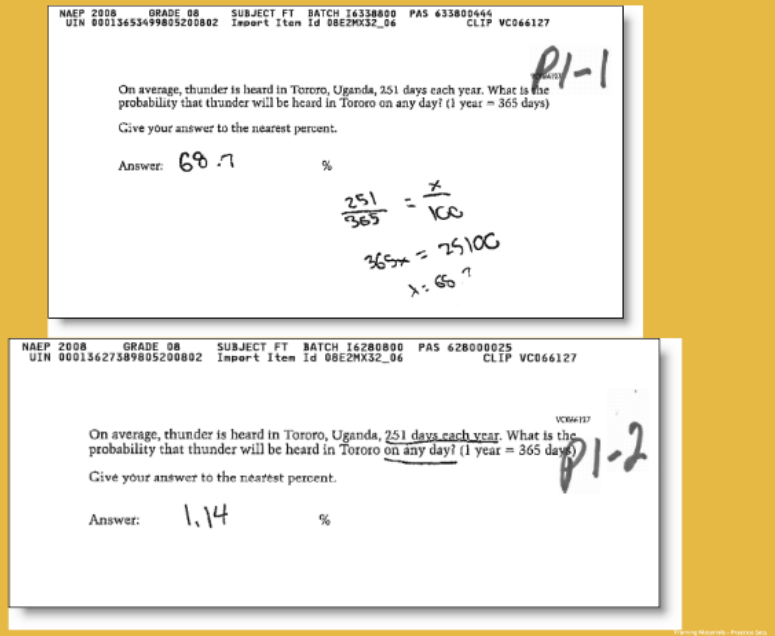
To qualify to score this item, the potential scorer must score 90% correctly.

Training Materials – Practice Sets

NAEP Mathematics
F2M8_06
Probability thunder Tororo
Practice Set #1

Paper	Ref #	Score	Notes
P_1-1	36	3	Response is correctly truncated at the first decimal place.
P_1-2	86	1	Response is incorrect.
P_1-3	189	3	Response is correct to the second decimal place.
P_1-4	33	3	Response is correct to the nearest percent.
P_1-5	154	2	Response is not given as a percent. The value is correctly calculated to the tenth decimal place.
P_1-6	45	1	Response is incorrect. The bar over the 8 indicates that this digit is repeated.
P_1-7	17	3	Response (*about 69%*) is correct to the nearest percent.
P_1-8	S2	2	Response is not given as a percent. The value is correctly calculated to the seventh decimal place.

Training Materials – Practice Sets



NAEP 2008 GRADE 08 SUBJECT FT BATCH I6338800 PAS 633800444
UIN 00013653499805200802 Import Item Id 08E2MX32_06 CLIP VC066127

P1-1

On average, thunder is heard in Tororo, Uganda, 251 days each year. What is the probability that thunder will be heard in Tororo on any day? (1 year = 365 days)

Give your answer to the nearest percent.

Answer: 68.7 %

$\frac{251}{365} = \frac{x}{100}$

$365x = 25100$

$x = 68.7$

NAEP 2008 GRADE 08 SUBJECT FT BATCH I6280800 PAS 628000025
UIN 00013627389805200802 Import Item Id 08E2MX32_06 CLIP VC066127

P1-2

On average, thunder is heard in Tororo, Uganda, 251 days each year. What is the probability that thunder will be heard in Tororo on any day? (1 year = 365 days)

Give your answer to the nearest percent.

Answer: 1.14 %

NAEP Questions Tool

The questions in the NAEP Questions Tool are presented for the use of teachers, parents, students, and others as: (1) examples of what NAEP asks students at grades 4, 8, and 12 for main NAEP, and at ages 9, 13, and 17 for long-term trend; (2) exemplars of questions that probe students' knowledge of a specific content area; and (3) a way to compare an individual's performance on a specific question to that of the students across the nation and in the state. For more information, visit http://nces.ed.gov/nationsreportcard/itmrlsx/landing.aspx

NAEP Item Maps

Item maps help to illustrate what students know and can do in NAEP subject areas by positioning descriptions of individual assessment items along the NAEP scale at each grade level. An item is placed at the point on the scale where students are more likely to give successful responses to it. The descriptions used in NAEP item maps focus on the knowledge and skills needed to respond successfully to the assessment item. For more information, visit http://nces.ed.gov/nationsreportcard/itemmaps/index.asp

Test yourself

Try sample questions in a variety of subjects for yourself. At the end of the quiz, see how students across the nation performed. For more information, visit http://nationsreportcard.gov/testyourself.asp

Interactive Computer Tasks (ICTs)

These tasks presented students with computer-based environments where students were asked to solve authentic scientific problems. There are nine released ICTs available to the public. For more information, visit http://nationsreportcard.gov/science_2009/ict_tasks.asp

Hands-On Tasks (HOTs)

These tasks gave students real-world contexts where students were asked to demonstrate how well they are able to plan and conduct scientific investigations, reason through complex problems, and apply their scientific knowledge. There are three released HOTs available to the public. For more information, visit http://www.youtube.com/watch?v=6RNpps7zdlE&list=PLkEhwZQdyNEEF3ayHdye-kweX7DyF3Awb&index=5

Introducing NAEP to Teachers

Educators explaining the importance of NAEP, the relevance of NAEP and how it applies to teachers. For more information, visit http://www.youtube.com/watch?v=zR1_pUdSlFg&list=PLkEhwZQdyNEEF3ayHdye-kweX7DyF3Awb&index=1
Create your own NAEP test and see what students know and can do. For more information, visit http://nationsreportcard.gov/educators.asp

Images property of NAEP; NAEP frameworks, data and assessment results were taken from NAGB, the Main NAEP NDE, NQT and The Nation's Report Card: 2009.

NAEP items can be used as a helpful educational resource in the classroom. Teachers can use the NAEP Questions Tool to see how students' performance compares on specific items. You can also request any information or specific research data from your NAEP State Coordinator, **Ashley McGrath at amcgrath@mt.gov.**

NAEP Webpage: http://opi.mt.gov/Reports&Data/NAEP.html

NAEP Wiki: http://opi.mt.gov/groups/montananaep/

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